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ABSTRACT #001

POLYSOMNOGRAPHIC FEATURES AND OSA PREVALENCE IN ADULT WITH DOWN SYNDROME

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Introduction: Oropharyngeal hypotonia, is common in individuals with DS, resulting in several impairments including the total or partial obstruction of the airways during sleep, leading to snoring and to obstructive sleep apnea (OSA). It is associated with a high risk of morbidity and mortality in individuals with DS. Several works investigated the sleep disorders in children with Down syndrome, but few studies are available in this adult population. This study aimed to assess the polysomnographic features and the prevalence of OSA in adult with Down syndrome.

Methods: Medical and dental anamnesis were performed in order to investigate the overall health, to address anthropometric data, dental status and parafunctional habits. Patients underwent the polysomnography (PSG) type II (Embla Embletta MPR+PG ST+Proxy, Natus, California-USA). The inclusion criteria included the presence of symptoms of OSA, preserved cognitive function to respond to verbal commands and informed and written consent. The exclusion criteria included body mass index (BMI) > 35 Kg/m2, and have been exposed to physiotherapy treatment at least 6 months prior to the study.

Results: The entire group consisted of 23 patients (14 males; 9 females), with a mean age 22.7±6.5 years, mean body mass index (BMI) 28.5±6.8 kg/m2 and neck circumference 39±4.0 (Table 1). Moderate to severe tooth wear was present in all patients. All patients presented Mallampati IV and, 17.4%, 30.4%, 52.2% tonsil grade I, II and III, respectively. The polysomnographic features showed a mean apnea/hypopnea index (AIH)=42.0±3.0, N3= 19.25±6.0, REM sleep=9.1±4.2, arousal index = 35.1±17.5, desaturation index (ODI)= 36.9±3.0, SaO2mean =92.0±4.0 and SaO2nadir=75.0±12.3. Mean sleep latency showed normal values (25±3.8), but mean REM latency was increased (203.0±78.0), with a decreased sleep efficiency (79.1±14.0). AIH was not correlated to BMI, neck circumference and age. All patients presented snoring. Sleep bruxism (SB) was present in 91.3% individuals. The prevalence of OSA was 100% (mild=21.7%, moderate=47.0%, severe=31.3%).

Conclusions: Adult with DS often present coexistent sleep disorders. Due to the high prevalence of OSA in this population, added to an increased ODI and marked sleep fragmentation, adults with Down syndrome should be screened for OSA with polysomnography, routinely.

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ABSTRACT #002

SLEEP AND AWAKE BRUXISM IN ADULT WITH DOWN SYNDROME EVALUATION

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Introduction: To our knowledge, no studies have accessed the awake bruxism (AB) and stage by stage sleep bruxism (SB) in adults with Down syndrome. The gold standard for SB diagnosis is polysomnography type I, but recent works have shown that the accuracy of portable PSG systems for SB is considered good even in absence of audio-video recording. To evaluate the prevalence of awake and stage-by-stage sleep bruxism in adult with Down syndrome through questionnaire answered by caregivers and PSG type II.

Methods: Twenty-three adults with Down Syndrome (DS) were enrolled in this study. Clinic examination, dental anamnesis, and RDC were performed in order to address anthropometric data, dental status, parafunctional habits

and temporomandibular symptoms. The history of SB/AB was answered by caregivers. A portable PSG type II system (Embla Embletta MPR+PG ST+Proxy, Natus, California-USA) was used to perform a full-sleep study at patients' home. Sleep data were visually scored according to the AAMS criteria and SB was scored according to the published rules. RMMA activity was defined as low (>1 and <2 episodes/h of sleep), moderate (>2 and <4 episodes/h of sleep), or high (>4 episodes/h of sleep). Subjects received the PSG diagnosis of SB if RMMA index was >2 episodes/h of sleep.

Results: The sample was composed by 23 adults with DS (mean age 21.7±4.3; 9 females, 14 males). All patients presented moderate to severe tooth wear and identations on tongue. Muscular and temporomandibular joint(TMJ) palpation presented 8.7% and 0% for local myalgia and TMJ, respectively. According to caregivers reporting, all patients presented AB and only 13.1% SB. PSG data showed a SB prevalence of 91.3%, with a mean RMMA index 40.0±30.0/h. When the RMMA index was separated by frequency, it was found 17.4% low RMMA, 21.7% moderate RMMA and 43.5% high RMMA. Only 2 showed RMMA index of 0.0/h. SB episodes were predominant in N3 and REM sleep stage in 14 and 9 patients, respectively. Clinical data showed probable AB. In addition, all patients presented obstructive sleep apnea 32.8±28.6 and snoring per hour 26.2±15.0. Despite the raised RMMA index, the majority of patients did not present TMD symptoms. Comparing caregivers reports with PSG data, they are not aware of the presence of SB.

Conclusions: The high prevalence of definitive SB and probable AB, added to the high prevalence of obstructive sleep apnea and snoring point to the recommendation for the PSG in adult with Down syndrome, routinely. Parents seem not to be aware about the presence of SB.

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ABSTRACT #003

A LARGE-SCALE POLYSOMNOGRAPHIC STUDY ON THE ASSOCIATIONS BETWEEN MASTICATORY MUSCLE ACTIVITY AND AROUSALS IN OSA PATIENTS

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Introduction: Previous studies have shown that contractions of the jaw-closing muscles (JCMs) often occur shortly after respiratory events during sleep in obstructive sleep apnea (OSA) patients. It has been hypothesized that sleep bruxism, characterized by rhythmic masticatory muscle activities (RMMAs), may contribute to the restoration of a compromised upper airway during respiratory events. However, a recent study suggested that JCM activities after a respiratory event in OSA patients are non-specific orofacial activities (OAs; e.g., swallowing, lip or tongue movement) dependent on the arousal response rather than on the respiratory events *per se*. Despite these outcomes, no large-scale polysomnographic studies on the associations between the type of masticatory muscle activity (OAs versus RMMAs), arousals, and breathing events in OSA have been performed yet. We hypothesized that JCM activity related to respiratory arousals in OSA patients are non-specific OAs, thus not RMMAs. Therefore, the aim of this study was to determine the relation between the type of JCM activity (non-specific OA versus RMMA) and respiratory arousals in OSA patients.

Methods: This prospective study included 221 consecutive new patients (53 ± 13 years), with a median apnea hypopnea index (AHI) of 13, recruited from the patient pool of a large sleep laboratory. All patients had a positive OSA diagnosis based on a baseline full polysomnographic recording, including EMG of the right and left masseter muscles. RMMAs and OAs were defined by internationally accepted criteria. RMMA index (events/hour of sleep), OA index, and respiratory arousal index were the primary outcome variables. Pearson correlations were performed to determine the relation between RMMA index and respiratory arousal index; and between OA index and respiratory arousal index.

Results: The medians, 25%, and 75% percentiles were calculated for RMMA index (0.9|2.2|4.4), OA index (3.6|6.0|9.6), AHI (8.1|13.0|29.4), total arousal index (5.7|9.9|18.2), and respiratory arousal index (1.3|3.0|6.7) for the total group. In line with our hypothesis, there was a significant correlation between OA index and respiratory arousal index (r=0.376, $P< 0.001$), while there was no significant correlation between RMMA index and respiratory arousal index (r=0.079, $P=0.245$). Among all patients enrolled in this study, the RMMA index of 56 out of 221 patients (25.3%) was of moderate intensity (RMMA index >2 and ≤4 episodes/hour), while that of 62 out of 221 patients (27.2%) was of high intensity (RMMA index >4 episodes/hour). For patients with moderate- and high-intensity RMMA, the correlation between OA index and respiratory arousal index was also highly significant (r=0.576, $P< 0.001$), while there was no significant correlation between RMMA index and respiratory arousal index (r=0.146, $P=0.141$).

Conclusion: The jaw-closing muscle activity shortly after respiratory events in OSA patients is a non-specific orofacial activity and is thus not related to sleep bruxism.

Support: Not applicable.

ABSTRACT #004

INCREASING ADHERENCE TO MANDIBULAR ADVANCEMENT DEVICES FOR OSA: 1-MONTH RESULTS

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Introduction: The prevalence of obstructive sleep apnea (OSA) is estimated at approximately 26% and 13% of adult males and females, respectively. Long-term adherence to treatment for chronic conditions in developed countries is estimated at 50%.

The aim of this study was to test whether a multifactorial intervention increases adherence rates in patients using a titratable oral appliance to treat OSA.

Methods: Subjects are 18 years old or older and have a diagnosis of OSA. Subjects were randomly assigned to the experimental or control group (routine care). Experimental subjects received additional printed material and communication monthly. Comparison of adherence was at 1-, 3-, and 6 months. Variables were: mean nights adherent to prescribed wear time (>4 hours, N>4), and the mean hours worn per night (H/N). Compliance was measured by a micro-sensor (DentiTrac, Braebon, Ontario, CA) embedded in the oral appliance.

Results: Ninety patients consented (39 females and 51 males), including 32 dropouts. Fifty have been recorded at 30 days (TP1, 20 female and 30 male). There were no significant differences between Control and Experimental groups for gender, age, and BMI ($p>0.05$) at TP1. At TP1 mean hours worn per night was marginally different ($p=0.0559$) 4.9h vs. 6.1h, Control and Experimental, respectively. Probability for wearing the appliance i.e., nights greater than 0.0 h and for nights greater than 4 h per night were significantly higher ($P<0.001$) in the Experimental group. Data for 3- and 6- months support the effectiveness of the experimental protocol to increase adherence.

Conclusions: Multifactorial intervention to increase adherence to oral appliance therapy for OSA was effective at 1 month. The number of nights wearing the appliance and the number of nights where the appliance was worn for 4 or more hours were significantly greater as a result of the intervention.

Support: This research was funded by a grant from the American Sleep Medicine Foundation and the American Academy of Dental Sleep Medicine. Support was also received from Braebon Medical Corporation who donated DentiTrac sensors.

ABSTRACT #005

EVALUATION OF QUALITY OF LIFE, SLEEP AND PSYCHOSOCIAL FACTORS IN CAREGIVERS OF INDIVIDUALS WITH DOWN SYNDROME

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Introduction: There is a need that is increasingly discussed in the scientific environment to shift the focus of attention from the disease to the person. The humanization of care and health care led to the triad disease / patient / caregiver. This caregiver can be both a professional and one who stays at home taking care of your loved ones, often compromising your own health. This study aimed to evaluate through questionnaires the quality of life, quality of sleep, and symptoms of depression, anxiety and stress in caregivers of individuals with Down Syndrome.

Methods: Nineteen caregivers (19) of individuals with Down Syndrome (DS) participated in this study. Inclusion criteria were fluency in the Portuguese language to answer the following validated questionnaires: Quality of Life Questionnaire (SF-36), Sleep Quality Index of Pittsburgh (PSQI) and Depression, Anxiety and Stress Scale (EADS-21). In addition to the questionnaires, the participants answered the following questions: age, marital status, gender, kinship and period devoted to caring for the relative with DS, working time, presence of the following factors that could influence sleep quality: caffeine drink consumption after 18h, tobacco use, physical exercise after 20h and use of medications. This research is linked to a main project that received FAPES research assistance and approval by CEPH ICT - UNESP (CAAE: 64173616.4.0000.0077).

Results: The caregivers had a mean age of 54.57±10.43, with a minimum of 27 and a maximum of 75 years. The sample consists mainly of married individuals (63.15%), female (78.94%), who are fully dedicated to the care of relatives with DS (47.36%). The SF-36 showed that the domains vitality, general health and pain were the ones with the lowest averages, 46.78±22.50; 51.36±19.12 and 52.42±33.03, respectively. The PSQI showed that 62.15% of caregivers have poor sleep quality and 31.37% some sleep disorder. In the EADS-21 the average stress, anxiety and depression scales were 7.26±6.20; 4.8±5.24 and 4.52±5.32, respectively.

Conclusions: The evaluations made evident some important aspects about the physical and emotional health of caregivers of individuals with Down Syndrome, making their health care essential. The data obtained in this research will allow us to establish the diagnosis of the pathologies studied and the indication of individualized therapies, envisaging new studies.

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ABSTRACT #006

MANDIBULAR ADVANCEMENT DURING DISE MAY IDENTIFY THE OPTIMAL ADVANCEMENT POSITION FOR ORAL APPLIANCE SUCCESS: PILOT STUDY

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Introduction: Drug Induced Sleep Endoscopy (DISE), Remote Controlled Mandibular Positioner and Airway Physiology studies show that a substantial number of patients may achieve effective therapy at protrusive distances less than 70%. One must maintain the balance between the degree of advancement and the side effects produced by too much advancement as along with the perceived lack of improvement represent the main sources for patient abandonment of OAT.

Objective: Utilizing DISE to select the optimal mandibular advancement level for predicting a successful oral appliance outcome.

Methods: 25 patients with Obstructive Sleep Apnea (OSA) who are candidates for OAT will be identified through our multi-disciplinary sleep clinic. Four patients have been evaluated so far and recruitment continues. Two or three protrusive bites were taken utilizing the George gauge during awake endoscopy in supine position. These protrusive bites were utilized during DISE in order to advance the mandible of the patient, thus mimicking mandibular titration taking place during OAT. During DISE, the Velum, Oropharynx, Tongue Base, Epiglottis (VOTE) classification were used to assess any relief of obstruction provided by these protrusive bites versus a patient's native collapse. IRB approval #HM20016074.

Results: First patient, 32 year old female AHI 10.2, BMI 26.73 and 10 mm of range of motion (-6 mm +4mm) was found to have cessation of snoring, slight improvement in partial collapse at tongue base and resolution of epiglottis/ hypopharyngeal collapse with 0mm of mandibular advancement.

Second patient, 74 year old male with AHI 17, BMI 23.05 and 11 mm range of motion (-2mm +9mm) was found to have resolution of tongue base collapse with 5 millimeters of mandibular protrusion, while interestingly, their tongue base collapse returned with 9 millimeters (maximum protrusive range of the patient) of mandibular protrusion.

Third patient, 54 year old male with AHI 32, BMI 30.13 and 12mm range of motion (-4mm 8mm) was found to have an improvement in the partial resolution of the oropharynx and tongue base with 2mm of mandibular protrusion; however, the collapse at both sites remained didn't show improvement at 4 mm and 6 mm of mandibular advancement.

Fourth patient, 46 year old male with AHI 16, BMI 25.49 and 7mm range of motion (-3 mm +4mm) was found to have a partial improvement in collapse at 1mm and 2mm of mandibular advancement but at the maximum comfortable position of 3mm there was a return off the complete collapse of velum but the epiglottis was noted to have no collapse from the baseline of complete.

Conclusions: All four patients showed some improvement in their airway collapse at a mandibular advancement less than 70%. Utilizing protrusive bites at different degrees, it is feasible to select the advancement level which leads to optimal airway opening. This technique may minimize the degree of mandible protrusion and contribute to both the efficacy of and compliance with OAT.

Support: N/A

ABSTRACT #007

THE EFFECTS OF MANDIBULAR ADVANCEMENT DEVICE THERAPY ON UPPER AIRWAY DIMENSIONS IN OBSTRUCTIVE SLEEP APNEA: RESPONDERS VERSUS NON-RESPONDERS

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Introduction: It has been suggested that the effects of mandibular advancement device (MAD) on upper airway dimensions differ among obstructive sleep apnea (OSA) patients. We hypothesized that responders to MAD therapy will show a larger increase of their upper airway dimensions with MAD in situ compared to non-responders. Therefore, the aim of this preliminary study was to compare the effects of MAD therapy on upper airway dimensions in OSA patients between responders and non-responders based on cone beam computed tomography (CBCT) images.

Methods: Twenty-eight OSA patients (mean ± SD age = 47.3 ± 12.3 years) were included in this study, which is part of a large-scale randomized controlled trial in which the efficacy of two types of MADs is compared: the SomnoDent appliance (SomnoDent® Flex™, SomnoMed Ltd, Australia; n=15) and the Herbst appliance (n=13). 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 recordings and two CBCT scans (NewTom 5G, QR systems, Italy): one at baseline (i.e., without MAD) and another after 12 weeks with their MAD in situ. Responders to MAD treatment were defined as having their apnea-hypopnea index (AHI) reduced >50% and <10 events h-1 at therapy evaluation; all others were regarded as non-responders. The primary outcome variable was the change in the minimal cross-sectional area of the upper airway (CSAmin). 2×2 ANOVA was used to investigate the simultaneous effect of responders versus non-responders and of the two types of MADs on the primary outcome variable.

Results: There were no significant differences at baseline between responders (n=14) and non-responders (n=14) regarding gender (Chi-square test; P > 0.05), age, Body Mass Index (BMI), neck circumference, AHI, and CSAmin (independent samples t-tests; all P-values > 0.05). Further, there was no significant difference between the two MADs in their effects on the change of the AHI with MAD in situ (P = 0.10). There was a significantly larger mandibular advancement with MAD in situ in responders (9.2 ± 2.1 mm) compared to non-responders (7.3 ± 1.4 mm) (t = 2.77, P = 0.01). However, no significant difference between responders and non-responders (F (1, 24) = 1.85, P = 0.19) or between the two types of MADs (F (1, 24) = 0.05, P = 0.82) on the change of CSAmin was found. After controlling for the difference in the mandibular advancement between both groups, there was still no significant difference between responders and non-responders on the change of CSAmin (P = 0.38).

Conclusions: Based on these preliminary findings, we concluded that the change in the upper airway dimensions of OSA patients due to MAD treatment is similar for responders and non-responders.

Support: This work is partially supported by research grant SomnoMed-Goedegebuure.

ABSTRACT #008

POOR SLEEP QUALITY IS LINKED TO OBSTRUCTIVE SLEEP APNEA IN JAPANESE SPORTS ATHLETES AND TREATMENT WITH A MANDIBULAR ADVANCEMENT DEVICE

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Aim: The sleep quality of Japanese footballers has not been previously reported. It is also unclear if obstructive sleep apnea (OSA) in part contributes to poor sleep in this group. This study assessed the subjective quality of sleep and documented the treatment effects of a mandibular advancement device (MAD), an oral appliance, in a small sample of those with OSA.

Method: Participants were 42 males and working adult elite rugby footballers who consented to this study (age: 26.3±3.7y, height: 176.3±5.8cm, weight: 89.5±12.1kg, BMI: 28.7±3.2). We administered the questionnaires (Pittsburgh Sleep Quality Index, PSQI, and Epworth Sleepiness Scale, ESS) and a Level III sleep test which evaluated Respiratory Disturbance Index (RDI) and SpO2minimum (SpO2min). Of the 27 diagnosed with OSA, six took up a custom-made MAD treatment. Participants were administered Numbers, a mobile phone reaction time test used for kinetic vision training within 15 minutes following waking, five days pre- and five days post-MAD treatment. Differences in study variables were evaluated by paired T-test. The study was approved by Nihon University School of Dentistry at Matsudo Ethics Review Committee (EC 17-12-012-1).

Results: The mean PSQI (N=42) was 6.8±2.9, of which 29 had PSQI>5 with a mean of 11.5±3.8. Of the 27 participants with OSA, 2 had severe OSA, 9 had moderate OSA, 16 had mild OSA and 15 did not have OSA. For the six participants who were treated with MAD, their baseline ESS was 13.7±2.0, RDI was 17.2±8.3/h, SpO2min was 82.3±5.4%, and the reaction time was 24.0±1.9s. Treatment with MAD resulted in significantly improved ESS to 8.8±1.7 (p<.001), SpO2min to 91.2±2.0% (p<.001), RDI: 5.6±3.2/h (p<.003), and the reaction time to 19.7±2.5s (p<0.01).

Discussion: Of the 42 footballers, 70.7% reported poor sleep by the PSQI and 64.3% had OSA ranging from mild to severe. Six who were treated with MAD showed improved ESS, RDI and SpO2min with significantly reduced reaction times. These improvements in kinetic vision through dental sleep treatment are interesting although sleep quality was not evaluated post-treatment. Future study trials will be required that evaluate the basis of poor sleep in Japanese athletes as well as MAD-related treatment improvements in kinetic vision to understand the relationship between sleep quality and kinetic vision.

ABSTRACT #009

THE COMPUTATIONAL FLUID DYNAMICS SIMULATION OF AIRWAY CHANGES DUE TO MAXILLOMANDIBULAR ADVANCEMENT SURGERY

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Introduction: Maxillomandibular advancement (MMA) surgery as a sleep surgery is useful for treating patients with obstructive sleep apnea. However, preoperative analysis and evaluation to make decisions about the direction and distance of maxillomandibular movement has previously consisted primarily of morphological analysis, and physiological functions have not been evaluated. In our study, a fluid simulation of airway changes associated with maxillomandibular movement, and the effects of these changes, was carried out, with the aim of achieving preoperative prediction. In this computational fluid dynamics (CFD) simulation, the actual measurements of flow made with patients were used, and an analysis closer to the clinical situation was thus achieved.

Methods: In this study, CFD simulation was conducted for 9 patients who had undergone MMA surgery, had undergone 3D-CT and rhinomanometry before MMA surgery and more than one year after surgery, and had given informed consent to participate. To evaluate jaw and airway morphology before and 1 year after surgery, all patients underwent 3D-CT. Airway images were extracted using INTAGE Volume Editor (version 1.1; Cybernet Systems Co., Ltd.), from 3D-CT DICOM data. A CFD mesh was prepared using unstructured meshing software. CFD simulation was carried out using FINE™/Open (version 7.2; NUMECA International). At the same time as CT, rhinomanometry was carried out by the anterior-mask method using a rhinomanometer. This study was approved by Nihon University School of Dentistry Ethics Committee (Tokyo, Japan; approval no. EP16D007).

Results: The simulation results were qualitatively consistent with the actual measurements, and the usefulness of the simulation was thus confirmed. The results of the simulation were within the error range for actual measurements and were therefore consistent with those actual measurements.

Conclusions: In this study, using actual measurements of patients' nasal patency, it was confirmed that simulation results and actual measurements are approximately consistent. On the basis of this finding, the following can be suggested: patients' actual respiratory dynamics can be approximately reproduced on the basis of the present simulation; if the parts of the airway with constrictions and/or high analyzed static pressure can be ascertained preoperatively, this will provide warnings about the potential for airway obstruction; and inclusion of the degree of movement during surgery results in a more meaningful analysis.

Support: This work was supported by a Grant-in-Aid for Scientific Research C (no. 19K10294) and grants from the Dental Research Center (2019), Nihon University School of Dentistry (Tokyo, Japan).

ABSTRACT #010

THE PUTATIVE PROTECTIVE ROLE OF JAW-CLOSING MUSCLE ACTIVITIES IN OBSTRUCTIVE SLEEP APNEA PATIENTS: A PILOT STUDY

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Introduction: Jaw-closing muscle activities (JCMAs) occur frequently in a close time relationship with apnea-hypopnea events (AHEs). This suggests that JCMAs might play a protective role against upper airway collapse (i.e., maintaining or restoring upper airway patency) in patients with obstructive sleep apnea (OSA). However, previous studies have reported inconsistent findings regarding the temporal association between JCMAs and AHEs. When regarding JCMAs that are unrelated to AHEs as muscle activities that have actually been successful in preventing AHEs, we hypothesized that in mild OSA cases the majority of JCMAs is unrelated to AHEs, while in severe cases the majority of JCMAs occur before, during, and/or after AHEs. In addition, we hypothesized that successful mandibular advancement appliance (MAA) therapy will increase the number of JCMAs that are unrelated to AHEs,

while that of JCMAs with a time link with AHEs will decrease, especially in severe cases.

Methods: Sixteen OSA patients (6 women, 10 men; 51.3±8.5 years; apnea-hypopnea index [AHI]=23.8±16.0 events/h; JCMA index=10.8±10.3 events/h) were included in this randomized controlled crossover trial. Polysomnographic (PSG) recordings were made without and with MAA treatment. A time span of 16 seconds between AHEs and JCMAs was applied to classify JCMAs into 4 possible sequences: 1) JCMA occurs before AHE (B-type); 2) JCMA and AHE occur simultaneously (S-type); 3) JCMA occurs after AHE (A-type); and 4) JCMA is unrelated to AHE (U-type). The number of JCMAs for each sequence were expressed as percentages of the total number of JCMAs. Ratios were calculated between BSA-types and U-type. Ratio values <1 signify dominance of U-type, while values >1 signify dominance of BSA-types. Independent-samples t-test was used to compare the ratios between mild (AHI<20 events/h; n=8) and severe (AHI≥20 events/h; n=8) cases in absence of treatment, while the effect of MAA therapy was assessed using paired-samples t-tests.

Results: In both conditions, i.e., without and with MAA therapy, the majority of JCMAs were classified as U-type (45.9% and 59.9%, respectively), followed by A-type (32.3% and 20.2%), B-type (20.5% and 18.8%), and S-type (1.2% and 1.2%). Without MAA therapy, the ratio between BSA-types and U-type for mild cases was significantly smaller than that for severe cases (0.59±0.47 and 7.00±6.37, respectively; T=2.835, P=0.013). In addition, while no significant treatment effects on the ratio were found for the entire study sample (T=2.091, P=0.054) or for the mild cases (T=0.427, P=0.682), in the severe cases the ratio decreased significantly with MAA in situ (T=2.518; P=0.04).

Conclusions: Severe OSA cases are characterized by more jaw-closing muscle activities that are unsuccessful in preventing apnea-hypopnea events than mild OSA cases. Treatment with mandibular advancement appliances is associated with an increase in the relative number of successful jaw-closing muscle activities. These preliminary findings corroborate the potential protective role of jaw-closing muscle activities in maintaining upper airway patency in OSA patients.

Support: SomnoDent® Oral Appliances and BRAEBON Medical Corporation compliance chips were gifted to the research with no obligations.

ABSTRACT #011

SKELETAL/DENTAL THREE- DIMENSIONAL CHANGES WITH USE OF MANDIBULAR ADVANCEMENT DEVICES

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Introduction: Mandibular Advancement Device (MAD) is a treatment option for obstructive sleep apnea (OSA). The aim is to analyze and determine changes in the position of dental and skeletal structures between CBCT images taken on patients currently using the MAD as a treatment modality for their OSA

Methods: Eighteen patients had CBCTs taken for MAD treatment. Landmarks were placed in different structures and distances/angles were calculated. Reliability was done measuring CBCTs of five patients three times. Descriptive statistics, repeated measures ANOVA and paired t-test were used.

Results: Landmarks presented excellent reliability, lowest being the z-axis of the right-most anterior-superior part of the coronoid process (ICC= 0.854). The largest mean change in distance was from the buccal furcation of 17 to 47 (-6.66+/--6.66mm). The largest mean change in angle was 27 buccal furcation-left lingula-left hyoid bone (-16.83+/- 27.30°). There is a mean distance change of 0.55mm and a mean angular change of 13.11° of all linear distances and angles assessed.

Conclusions: Vertical linear skeletal changes with placement of a MAD include a vertical increase of the mandible relative to the maxilla and a superior movement of hyoid bone relative to mandible. AP linear changes include mandibular protrusion and anterior movement of the hyoid bone relative to the cervical vertebrae, and an anterior movement of the hyoid bone relative to the maxilla. Angular movements include the rotation of the hyoid bone antero-superiorly. Skeletal repositionings should be correlated with patient symptoms to determine if short or long-term usage of the MAD is indicated for patients. Assessing specific tendencies with the use of the MAD will aid clinicians to also predict outcomes of skeletal changes to ultimately decide the best candidates for this type of treatment.

Support: No support

ABSTRACT #012

THE RELEVANCE OF AWAKE MAXIMAL COMFORTABLE PROTRUSION AS A STARTING POINT FOR MAD-TITRATION IN OSA PATIENTS – PRELIMINARY RESULTS.

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Introduction: There is no consensus on mandibular advancement device (MAD) starting protrusive position. The present study (1) compares the awake maximal protrusion (MP) and maximal comfortable protrusion (MCP) with their effect on the upper airway during DISE (2) and the efficacy of 'awake MCP' as starting position for MAD-therapy in terms of titration.

Methods: 100 patients diagnosed with OSA on polysomnography were consecutively included for MAD treatment to follow upon DISE evaluation (M/F=62/38; age=48± 12years; baseline (BL) apnea-hypopnea index (AHI)=24.6±15.4/hr sleep; BL body mass index (BMI)=27.5±4.1kg/m^2). With a bite registration (BiteFix, Scheu Dental, Germany) awake MP and MCP were registered. DISE was initiated in 'awake MCP', followed by gradual protrusion towards 'DISE MP' and this position was marked again. The 'DISE MCP' position was scored by the ENT-specialist as the protrusion with the most benefial effect on upper airway opening and/or stability. All positions were measured with a digital caliper to .1mm accuracy. Decisions during DISE were noted as "start in 'awake MCP'", "more protrusion than 'awake MCP' required", or "not a suitable MAD candidate". All patients were fitted with a MAD (Somnomed Flex, Somnomed-Australia or Narval CC, Resmed-France) with treatment starting in 'awake MCP'. Improvement in complaints on snoring was used as subjective guidance for titration. After 3 months, MAD protrusion was measured again and home-polygraphy for AHI was carried out. 27 patients have a full data set (M/F=22/5; age=51±14years; BL AHI=31.7±14.3/hr sleep, BL BMI=26.3±4.1).

Results: in the subgroup of 27 patients: 'awake MP'= 13.1±2.6mm, 'awake MCP'= 10.2±2.2mm being 78.1±8.5% of the 'awake MP'. 'DISE MP'= 13.7±2.5mm, 'DISE MCP'= 10.1±2.2mm being 73.5±9.8% of the 'DISE MP', 'AHI with MAD'= 11.1±8.6/h sleep. Statistical analysis was performed with R. A statistical significant improvement in AHI was found upon MAD treatment ($p<0.0001$). 'awake MCP' differed significantly ($p=0.003$) from 'DISE MCP', but presumably not clinically relevant at .14mm difference. Patients that titrated after starting in 'awake MCP' upon resolution of snoring complaints (n=14) showed a significant ($p=0.045$) higher delta AHI of 72% vs. 50% in patients that did not titrate (n = 13).

Conclusions: 'awake MCP' corresponds clinically with 'DISE MCP'. Starting MAD treatment from 'awake MCP' eliminates additional titration as guided by subjective complaints on snoring in 50% of patients studied. Patients that performed additional titration showed a higher delta AHI than patients that did not need to titrate.

Support: no support received.

ABSTRACT #013

USE OF MANDIBULAR POSITIONING DEVICE DURING DRUG INDUCED SLEEP ENDOSCOPY FOR PATIENT SELECTION IN ORAL APPLIANCE THERAPY: OBSERVATIONAL MULTICENTER STUDY IN PATIENTS WITH PRIMARY SNORING AND OBSTRUCTIVE SLEEP APNEA.

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Introduction: Mandibular advancement devices (MAD) are indicated in the management of sleep related breathing disorders (SRBD) including primary snoring, and obstructive sleep apnea (OSA) as an alternative to PAP therapy for patients who prefer an oral appliance, or those who refuse or are unable to tolerate PAP therapy. However, MAD have been found to be ineffective in one third of patients. Thus, there is a need to develop validated methods to identify patients who will respond to MAD prior to the initiation of therapy.

Drug induced sleep endoscopy (DISE) provides useful information about the collapsibility of the upper airway. The most common procedure to screen patients for MAD during DISE is bimanual protrusion. However, no correlation has been shown between bimanual protrusion during DISE and MAD treatment outcomes. Therefore, it is important to optimize the mandibular positioning procedures in order to increase the predictability of MAD treatment outcomes.

The aim of this study was to assess the response in patients with SRBD to a new titratable mandibular positioning device during DISE to predict MAD treatment outcomes.

Methods: 123 patients with SRBD including primary snoring and mild to severe OSA were included in this study. All subjects underwent DISE and different ranges of protrusion were established by means of a titratable mandibular positioning device. The VOTE scale was then used to evaluate the changes in volume and collapsibility of the upper airway at the level of the velopharyxn, oropharynx, tongue, and epiglottis.

Results: The upper airway was compared with and without mandibular advancement. The group of primary snoring presented differences at the levels of the velo and oropharynx. The group of subjects with mild OSA presented differences at the tongue level in addition to the abovementioned. Lastly, moderate to severe OSA subjects presented changes at all levels.

Posteriorly, the impact of mandibular advancement was analyzed. Subjects with primary snoring and mild to moderate OSA presented variable changes depending on the level, whereas in severe OSA subjects, changes were equivalent across the different levels. Based on these results, MAD as single therapy was recommended in 70,06% of subjects with primary snoring, 81,8% in mild OSA, 73,9% in moderate OSA, and 31% in severe OSA. In addition, MAD was also recommended in combination with other therapies in 5,9% of primary snoring, 9,1% mild OSA, 13% moderate OSA, and 40,5% in severe OSA subjects.

Conclusions: Both responders and non-responders to mandibular advancement under sedation could be identified prior to initiation of therapy. The use of a mandibular titratable positioning device will allow the establishment of the optimal mandibular advancement, tailoring the treatment plan to the individualized needs of patients, and optimizing treatment outcomes by minimizing the rate of failures in non-responders to MAD.

Support: None

ABSTRACT #014

TREATMENT OF PATIENTS WITH SEVERE OSA SECONDARY TO PAP INTOLERANCE

Radmand R, Vena D, Sands, S.

Introduction: Treatment of severe obstructive sleep apnea (OSA) with oral appliances has traditionally been second line option after a patient becomes intolerant to positive airway pressure (PAP) therapy. PAP therapy is highly efficacious but suffers from low rates of adherence. Furthermore, when patients fail PAP therapy they often remain untreated for long periods. If oral appliances can treat severe OSA, it might be worthwhile to consider oral appliances earlier in the treatment pipeline. The current abstract reports a retrospective analysis of clinical data exploring the effect of oral appliances on patients with severe OSA. We hypothesize that some patients with severe OSA can achieve a complete response with oral appliance therapy.

Methods: Patients with severe OSA (supine AHI > 30 events/hr) that previously failed PAP therapy presented for an initial evaluation and consultation with a qualified sleep dentist. Demographic data as well as the data they stopped using PAP therapy were recorded. Patients received final impressions or digital scans to be fitted for an oral appliance (ProSomnus [IA], ProSomnus Sleep Technologies, Pleasanton, CA). After delivery of the oral appliance, patients were followed up every 48 hours to titrate the device until subjective relief of OSA symptoms was achieved. After OAT of > 8 weeks, patients underwent a second polysomnogram to measure their OSA severity on OAT.

Results: Eight patients were included for preliminary analysis (6 men, BMI: 30.0±6.1 kg/m^2, age: 60±6 years, baseline AHI: 32.1±14.9 events/hr, supine AHI: 49±14.2 events/hr,). Patients experienced a mean reduction in total AHI of 62±31% (treatment AHI: 11.5±8.2 events/hr) and supine AHI of 72±27% (treatment supine AHI: 13.9±13.6 events/hr). A complete response (at least 50% reduction in AHI and treatment AHI < 15 events/hr) was achieved in 5/8 patients. Additionally, a complete response in supine (at least 50% reduction in supine AHI and treatment supine AHI < 15 events/hr) was achieved in 4/8 patients. Average "none-therapy gap" (i.e. time from when they last used therapy for their OSA) was 24 months.

Conclusions: Oral appliance therapy was highly efficacious in the severe OSA patients studied, with over half of the patients achieving a complete treatment response. Before they were prescribed oral appliances, these patients experienced a long period of time where their severe OSA was left untreated. Taken together, these results suggest that oral appliance therapy should be offered to patients earlier in the treatment pipeline. Future is work is focused on adding to this pool of data to provide more evidence that severe OSA can be treated with oral appliance therapy.

Support: None

ABSTRACT #015

MINIMIZATION OF TITRATION PROTRUSION FOR THE EFFICIENT TREATMENT OF OSA

Sall ET

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Introduction; The purpose of this investigation is to contribute to the understanding of OAT titration range utilizing a large population of data. Specifically: what

percentage of patients are treated to standard of care OAT with 3mm or less titration from the starting position; what percentage of patients require between 3mm and 4mm titration from the starting position; what percentage of patients require between 4mm and 5mm titration; and what percentage of patients require more than 5mm of titration? This analysis will be performed for a single center practice (n=423), and for a large database (n=l3,328) of consecutive cases.

However, little has been presented in evidence on bite position and the degree of titration needed to treat a patient. Oral appliance design has traditionally focused on the ability to titrate over an extended range often up to 12mm. However, although the ample range is useful for flexibility in treatment, the dynamics of the relationship of the mandible to the maxilla across that range can change dramatically. Having the initial position of the patient's treatment start at or close to the final treatment position can reap benefits in terms of patient comfort, adherence, reduction in side effects, speed to treatment and optimization in the office when seeing patients.. A retrospective analysis of titration protocol using proprietary CAD/CAM sleep device designed for patient comfort and protrusion optimization has been done in an AADSM diplomate's office. The practitioner treats all patients to the AADSM standard of care with the goafof AHI/RDI/REI (<5, <10, >50%). Patients were treated with the ProSomnus [IA] Sleep Device (ProsSomnus Sleep Technologies, Pleasanton CA), an iterative style oral appliance with an initial delivered range of 3mm capable to reach up to 12mm with an unlimited arch protocol. The practitioner has the option of ordering as many additional arches at no charge to achieve the standard of care goal.

Method: 423 sequential cases were reviewed in terms of extra arches ordered in addition to the 4 delivered with a range of 3mm. The number of single arches representing an additional 1.0 mm of titration was calculated as a percentage of total orders over the same time period. These cases are at least 6 months passed the seating date and treatment was complete. The patient's bite is taken at a comfortable position, often near edge to edge and captured using an intraoral scanner to document the patients bite and dentition. To understand the perspective of this data, I requested from the manufacturer to replicate this calculation for a larger data set with more practitioners.

Results: Of the 423 patient cases reviewed, 72 of those cases required an extra arch, which in turn means that, 351, or 96%, on average, of the patients did not. These 423 patients reached their treatment goals within a 3mm titration range. The manufacturer provided data on 13,328 sequential cases that were shipped at least 6 months prior to the request, providing time for completion of treatment, for ProSomnus [IA] with additional arch orders numbering 2,459. 81.6% of the cases ordered were treated within the default protocol of 3mm, 18.4%, on average required an additional arch reaching to 4mm.

Conclusion: An iterative device offers a unique opportunity to understand en masse, the nature of a successful titration protocol. With trained DSM, doctors and a custom MAD that preserves protrusion position and enables space for the tongue, 81.6% of the patients, on average, can be treated within 3mm of the initial bite position assuming the standard of care protocol.

ABSTRACT #016

OBSERVATION OF VERTICAL CHANGES TO AN ORAL APPLIANCE IN OSA

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Introduction: In this observational study, we wanted to observe changes in vertical opening (VDO) while wearing a Mandibular Repositioning Device. It is our routine to add VDO when short of ideal sleep study outcomes. We also sought to replicate our earlier findings that demonstrated increased VDO may improve outcomes in some patients (Morgan et al.) This pilot study report is intended to establish a basis for further investigation that will help clinicians plan the proper vertical positioning of the mandible at the time of construction bite registration.

Materials and Methods: Twenty consecutive patients who had previously failed a trial of PAP therapy and then referred to the dentist, were examined and worked up in the usual manner for trial of oral appliance therapy (OAT). Ten patients were fitted with the Narval® oral appliance (Res Med Corp., San Diego, CA).Ten additional patients were fitted with a Panthera D-SAD Device (Panthera Sleep Quebec, Canada).

Titration Plan and Change in isolation of VDO: Upon delivery of the custom appliance patients were instructed to make 1mm further protrusive adjustments every 1-2 weeks to their appliance until subjective symptoms of snoring, nocturnal arousals and observed apneas improved, or they reached their maximum tolerance to further advancements.

At their return appointment a progress home sleep test (HST) was administered. If the goal of AHI <10/hr was not reached, a novel “vertical tab” was added at the molar or bicuspid region to increase the inter-incisal distance by 2mm, for a total of 7mm. The tabs allow for a change in vertical dimension while the holding protrusion setting constant. No further adjustments to protrusion were made and a second HST was dispensed to examine the effect of vertical change upon AHI and oxygen desaturation index (ODI) in isolation.

Results: Response to added VDO was effective in some patients, primarily male patients. Adding 2mm of additional VDO had a significant effect in improving final AHI, while holding protrusion a constant. Out of the 20 subjects considered in this clinical series, AHI was reduced significantly from a mean AHI of 24 (baseline with Oral Appliance Therapy) to 13/hr (protrusion only at 2mm opening with George gage), and then by an additional 31% with added VDO Tabs. This was a statistically significant change (student T-test) of p=0029. Oxygen saturation mean improved from 92 to 94 % across the sample.

Conclusion: Not all patients showed an improvement with added vertical of 2mm. Some of this may be explained by night-to-night variation, and alcohol use was not controlled. Most said in a satisfaction questionnaire that they were more comfortable with the increased VDO, which we speculate is a function of "cushioning" between trays or improved outcomes. Statistical analysis in comparing the means for initial outcome and then with added vertical in this group and it was our primary goal to observe this change without added protrusion, and should be considered by treating clinicians as an additional option to improve outcomes.

Support: Appliance were provided by Narval and Panthera to the author

ABSTRACT #017

APPLICATION OF COMBINATION THERAPY IN THE SEVERE, CPAP RESISTANT SLEEP APNEIC PATIENT

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Introduction: Combination Therapy using an interface to connect CPAP with an oral appliance is a rarely used therapy when attempting to control the patient with severe OSA. Up to this point in time, minimal research has been performed validating the procedure, yet it has been used successfully by a relatively small group of clinicians treating patients that have been considered untreatable.

Report of Case: Patient is a 53-year-old female with a BMI of 35.5 at her last recall appointment. Her current medical history includes hypertension, type 2 diabetes, depression, hypothyroidism, insomnia and chronic fatigue. Past medical history of asthma and heart attack in 2010. The patient is CPAP intolerant and was untreated at the initial time of treatment. A 2011 in-lab PSG showed an AHI of 111 and nadir 81%. Best titrated pressure was 15 cmH2O.

Treatment was initiated in 10/2014 using Combination Therapy through an interface, TAP-PAP Chair side (CS) interface, attached to a TAP 3 (TL) oral appliance. Master impressions were taken with a highly refined alginate impression material and the bite was taken at an incisal edge to edge bite position. When seated, the appliance was initially titrated to maximum protrusion, 12 full turns, with no discomfort. Pressures were set at 4-20 cmH2O. The first download taken from the first night showed a reduction of her AHI from 111 to 3.7. Mean pressure was 5.1 cmH2O. At the end of two weeks her APAP download showed an AHI of 3.5 with 0 leaks and average pressure of 6.8 cmH2O.

Patient was referred back to her physician of record and placed into our recall system. Her physician decided no further post-treatment testing was required. The patient did not return to our office until 7/2018 for recall. She did require a new oral appliance and interface. Follow-up treatment showed an AHI of 2.7, average usage of 6 hours 11 minutes, median pressure 6.4 cmH2O. Final oximetry revealed T90 of 96.6% with somewhat elevated desaturation indices. Subjective symptoms at follow-up were Epworth of 6 and Fatigue scale of 15.

Discussion: With Combination Therapy, this patient was able to control her previously untreatable sleep apnea. Simultaneous use of PAP and oral appliance allows for reduced therapeutic pressures and comfortable jaw advancement. The interface provides for a stable platform for the nasal pillow attachment. The platform allows for minimal air leakage, increased patient mobility, minimal claustrophobic issues, and no scalp contact (which is important with fibromyalgia patients having hypersensitized scalps). This case study shows successful treatment of a severe sleep apneic patient who was non-compliant with conventional treatment. Combination Therapy is an underutilized treatment that can increase treatment success for the severe CPAP intolerant sleep apnea patient.

Support: None

ABSTRACT #018

DIGITAL WORKFLOW FOR MAXILLARY EDENTULOUS PATIENTS IN THE ACQUISITION OF RECORDS AND FABRICATION OF AN ORAL APPLIANCE

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Introduction: Fabrication of complete dentures has been a cornerstone in the practice of dentistry for 100 years. Digital workflows for the fabrication of complete dentures have been in use for several years. Traditionally,

workflows involving the fabrication of a complete denture have necessitated 3-5 office visits. Workflows for the fabrication of an oral appliance for an edentulous patient can be very similar to complete denture fabrication. In this case study I will show that fabrication of an oral appliance for a maxillary edentulous patient can be done in 2 appointments. I will show that delivering an oral appliance can be done at the second visit eliminating the wax try in stage. This serves many purposes, including a decrease in chair time, decrease in cost, faster treatment time, less inconvenience for the patient.

Report of Case: An 85 year old Caucasian male was referred to my office from his sleep physician with a diagnosis of moderate obstructive sleep apnea. A complete medical history was taken including a CBCT scan. Positive medical history of hypertension and diabetes. Clinical examination revealed the patient in a complete maxillary denture with 10 teeth in the opposing arch. Further examination showed that the denture was ill fitting and would not be able to accommodate an oral appliance. A decision was made to make an edentulous oral appliance to the existing dental arch using the digital workflow proposed. Digital scans were taken of the edentulous arch, the opposing dentition and the denture itself. The denture was placed back in the patient's mouth, and a protrusive bite record was taken with the George Gage. As an alternative, a PVS impression may also be taken of the upper arch. A wash impression was taken to maximize the accuracy of the fit of the denture. The scans were sent to BonaDent dental lab (Seneca Falls New York) for fabrication of the edentulous Herbst oral appliance.

Discussion: The possibility of streamlining the appointments required from initial consult to delivery of an oral appliance into 2 visits has many advantages. Patients with sleep disordered breathing will benefit from a faster time into treatment. With the elimination of a wax bite appointment for the acquisition of a protrusive bite record means that the delivery of the appliance to the patient will be quicker and will not have the patient return to the office for an additional visit. By implementing a digital workflow, shorter appointment times may be possible. A decrease in chair time means that additional costs to the dentist for multiple visits may decrease. Opening chair time affords the dentist to maximize office scheduling efficiency.

Support: None

ABSTRACT #019

USE OF FULL-ARCH AM ALIGNER VS. SHORT AM ALIGNER IN THE MANAGEMENT OF POSTERIOR OPEN BITE SECONDARY TO THE USE OF MANDIBULAR ADVANCEMENT DEVICE- A CLINICAL PEARL

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Introduction: Permanent side effects, secondary to the use of Mandibular Advancement Device(MAD), in about 18% of the patients are decrease in overjet, overbite, and posterior open bite (POB). The etiology of secondary POB has been hypothesized to be related to intrusion of teeth, palatal inclination of upper incisors, changes in the architecture of mandibular fossa, or an irreversible contracture of lateral pterygoid muscle. Several treatment options have been proposed to counteract POB, including the use of thermoplastic or CAD-CAM fabricated morning aligners, jaw exercises, and gum chewing. In this case report, we present the use of a custom- fabricated, thermoplastic morning aligner (short AM aligner) that rests on teeth #6-11 to rectify the bilateral POB developed secondary to the use of MAD for the management of OSA.

Report of the Case: Patient presented to our clinic on December 2018 with an AHI of 53, consistent with a diagnosis of severe OSA. Reportedly, she was using CPAP unsuccessfully for months and therefore considering alternative options. She had full natural dentition. No dental pathology was noted. Shim stock revealed bilateral, and even occlusal contacts. Once her treatment with MAD (CAD- CAM fabricated) was initiated, she was advised to perform jaw stretching exercises for 5 minutes upon MAD removal, followed by the use of a full-arch maxillary AM aligner for 5 minutes. During her follow up visits patient reported to be compliant with the full-arch AM aligner as instructed but not the exercises. However, a bilateral posterior open bite was noted after three months of therapy. She was then started on a short AM aligner to be used for ten minutes upon removal of MAD. Over the course of next three months, her occlusion was fully reestablished. At six-month recall, no POB was noted. Patient was referred to the sleep physician for sleep study with the MAD in place.

Discussion: It has been recently reported that while dental changes do occur, skeletal remodeling does not. There seems to be a scarcity of literature regarding muscular alterations in response to MAD therapy. We hypothesize that the persistent shortening of inferior lateral pterygoid muscle may contribute to developing a POB. MADs protrude the mandible by the action of inferior lateral pterygoid muscles. The short AM aligner helps guide the mandible to its habitual position. The act of retrusion and clenching activate the superior head and relax the inferior

head of lateral pterygoid. This negates the effect of MAD upon waking and aims to restore the patient's habitual occlusion. The short aligner further creates a pivot anteriorly, so the patient has to focus on bringing their posterior teeth together. Compared to full-arch AM aligners, the short AM aligner also removes the thickness of the material posteriorly so that patients can actually contact their teeth together. This case report presents better outcomes with a shortened AM aligner than a full-arch coverage AM aligner in the prevention and management of POB secondary to MAD.

Support: None

ABSTRACT #020

ORAL APPLIANCE VS. SUPINE AVOIDANCE THERAPY SELECTION CRITERIA IN PAP-FAILURE PATIENTS

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Introduction: Oral appliance (OA) therapy is the most commonly recommended treatment option for patients who fail or refuse Positive Airway Pressure (PAP). The majority of these patients suffer from positional obstructive sleep apnea (POSA) and might alternatively benefit from supine avoidance therapy. This study investigated the conditions under which one therapy might be preferable to the other.

Methods: Consecutively acquired data from 151 patients with a diagnostic AHI $\geq$ 5 and who failed or refused PAP was retrospectively analyzed. The mean age was 55$\pm$12.7 years; 40% were female. Patients were fitted with a trial "OA" (Apnea Guard®, Advanced Brain Monitoring, Carlsbad, CA) at 70% of the distance from neutral bite to maximum protrusion with fixed vertical mouth opening. Vertical dimension of occlusion was selected based on tongue size, with females fitted at 5.5 or 6.5 mm, and males fitted at 6.5 or 8 mm. Two-night home sleep apnea tests (HSAT) were performed at baseline on Night 1 and with the OA on Night 2.

POSA were characterized when the overall/non-supine AHI ratio was $\geq$1.4 with a non-supine AHI <20 and at least 20-minutes of supine and non-supine time. Patients with <20-minutes supine time were labeled supine dominant. Supine or non-supine AHI values based on <20-minutes were excluded. The benefit of supine avoidance (SA) was projected using the pre-treatment "non-supine AHI" from either the diagnostic or baseline study, whichever was greater. OA and SA were considered equivalent if the differences between the overall OA-AHI and the non-supine AHI were <5 events/hour, the balance were then characterized as superior/inferior based on which AHI was lower/higher. Mann Whitney U tests were used to compare treatment conditions.

Results: Clear candidates for OA therapy (n=76) included the 31% who were non-POSA and 19% who were supine dominant. The balance of patients with POSA (i.e., 50%, n=75) were stratified into Group 1 with a non-supine AHI<5, Group 2 with a non-supine AHI between 5 and 10, and Group 3 with a non-supine AHI $\geq$10. In Group 1 (n=30), OA reduced the AHI by 33$\pm$55% vs. 77$\pm$19% for SA ($p<0.0001$); the therapies were equivalent in 18 cases and OA was inferior in 12 cases. In Group 2 (n=22), OA reduced the AHI by 43$\pm$25% vs. 57$\pm$15% for SA ($p=0.07$); the therapies were equivalent in 17 cases and OA was inferior in 5 cases (all with a pre-treatment supine AHI >25). In Group 3 (n=23), OA reduced the AHI by 48$\pm$47% vs. 47$\pm$9 for SA (p=ns); the therapies were equivalent in 10 cases, SA was inferior in 10 cases, and OA was inferior in 3 cases.

Conclusions: OA was preferable in 70% in those who failed PAP, i.e, were non-POSA, supine dominant, had a pre-treatment non-supine AHI >10, or a supine AHI <25 and a non-supine AH between 5 and 10. SA appeared preferable in the 30% of the cohort, including those with pre-treatment POSA and a non-supine AHI <5, or POSA with a non-supine AHI between 5 and 10 and a supine AHI $\geq$25.

Support: None

ABSTRACT #021

THE INFLUENCE OF SEX, TONGUE SIZE AND SLEEPING POSITION ON ORAL APPLIANCE THERAPY OUTCOMES

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Introduction: Due to inconsistencies in the existing evidence, factors that may influence successful oral appliance (OA) therapy outcomes are controversial, and thus, inconsistently presented for consideration in dental sleep medicine training programs.

Methods: A within-subject, repeated-measures design was used to evaluate 65 adult patients (age 53$\pm$11.9 years, 40% female) with a diagnostic AHI $\geq$ 5 who responded to a "Trial" OA and then fitted with a "Custom" OA.

The Custom was fabricated with 2-3 mm vertical dimension of occlusion (VDO) for females and a 5mm VDO for males, at 70% of the distance from maximum retrusion to maximum protrusion measured with a George Gauge bite fork. Vertical mouth opening (VMO) was not

controlled with mandated use of vertical elastics. The Custom was titrated by the dentist to the perceived optimal endpoint.

The Trial (Apnea Guard®, Advanced Brain Monitoring, Carlsbad, CA) was fitted to 70% of the distance from neutral bite to maximum protrusion. VDO was selected based on sex and tongue size, with females at either 5.5 or 6.5 mm VDO and males at either 6.5 or 8 mm VDO depending on scalloping. The predicted target protrusion setting was used to assess efficacy. The VMO of the Trial was fixed.

Two-night home sleep apnea tests (HSAT) were performed at baseline on Night 1 and with the Trial on Night 2. Efficacy HSATs were completed after the dentist determined the Custom was optimally titrated. Mann Whitney U and Chi-squared tests were used to compare sex and OA feature differences.

Results: Overall AHI reductions from baseline in males with scalloped tongues at 5 vs. 8 mm/VDO were 37±37% vs. 61±17%, respectively ($p<0.001$, n=25). VDO differences impacted the proportion of scalloped-tongue males that achieved >50% reduction in non-supine AHI (61% vs. 78%, respectively, p=0.003). In males with non-scalloped tongues, the overall AHI changes resulting from 5 vs 6.5 mm/VDO were not significant (46±24% vs 57±16%, p=0.17, n=24). Significantly greater supine AHI reductions were observed across males (48±32% vs. 63±15%, $p<0.02$), but not when stratified by tongue size.

Females with scalloped tongues had significantly greater body mass vs. non-scalloped tongues (34.2±8.0 vs. 25.3±5.6 kg/m^2). In females with non-scalloped tongues, the overall AHI reductions at ~2-3 mm vs. 5.5 were 46±30% vs. 69±21%, respectively ($p<0.05$, n=11). Females with scalloped tongues were unaffected by VDO differences of 2-3 vs. 6.5 mm (33±0.60% vs. 42±24%, p=0.42, n=15). There were no differences in outcomes when females with scalloped and non-scalloped tongues were fitted at 2-3 mm VDO (33±61% vs. 46±30%, p=0.26). Females with non-scalloped tongues at 5.5 mm VDO exhibited a significantly greater OA response vs. those with scalloped tongues at 6.5 mm VDO (70±21% vs. 42±24%, p=0.007).

Conclusions: OA outcomes are influenced by the interaction between sex, tongue size and sleeping position. In males with scalloped tongues, increased VDO contributes to superior outcomes. In females, overall efficacies improve with at least 5 mm VDO. Females with non-scalloped tongues respond better to OA therapy compared to females with scalloped tongues. Controlling VMO contributes to improved supine OA outcomes.

Support: None

ABSTRACT #022

MANDIBULAR ADVANCEMENT ORAL APPLIANCE TO TREAT OSA IN ADULT WITH DOWN SYNDROME: A POSSIBLE OPTION WHEN CPAP IS NOT ACCEPTED

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Introduction: Obstructive sleep apnea(OSA) is highly prevalent among individuals with Down syndrome (DS), and can trigger systemic alterations related to cardiometabolic risk such as hypertension, stroke and diabetesII. The most common recommended treatment of OSA, among this population, is Continuous Positive Airway Pressure(CPAP). Although, this therapy is not tolerated by a large number of people with DS. There is a lack in literature regarding the usage of mandibular advancement oral appliance(OA_m) in adults with DS. The aim of this study was to evaluate the effects OA_m on OSA, in adults with DS.

Report of case: Caregiver complained of excessive movement during sleep but did not report the presence of snoring and sleep bruxism(SB) during anamnesis appointment. The only reported comorbidity was hypothyroidism. Female patient was evaluated by a sleep physician and sleep dentist. The demographic and anthropometric data consisted of 32years-old, body mass index(BMI)=24Kg/m^2, neck circumference=35cm, abdominal circumference(AC)=86cm, waist-to-hip ratio (WHR)=0.78. The diagnosis of OSA was given by typeII PSG (Embla,Embletta,MPRPGPROXY+ST), which showed a mild OSA, and patient was referred to OA_m. The appliance chosen was PMPositioner®, which allows lateral movement of mandible and does not invade the space of tongue, with a thermo-sensitive microsensor(TheraMon) embbeded, in order to obtain the objective compliance. After 4 months, a new PSG was carried out with OA_m*in situ*, to evaluate the efficacy of therapy. The patient used OA_m without difficulty, and also, performed the appliance placement and removal without the assistance of her parents, according their report. The results showed decreasing of respiratory disturbance index (RDI) from 10.6 to 4.8, improvement of oxihemoglobin desaturation index (ODI) from 4.9 to 3.0 and raising of SaO2minimum

from 89% to 91%. The mean duration of apnea events reduced from 21min to 15 min. The objective compliance, measured by microsensor, was 97%.

Discussion: The efficacy of OA_m treatment to OSA showed in this study point to an acceptable therapy option in adult with DS, once it was comfortable, safe and well tolerated. The prevalence of OSA and cardiovascular risk in this population range from 50-90% and 50-70%, respectively. Several studies show that people with DS and OSA don't accept CPAP therapy. The one study performed with OA_m in adult with DS individuals showed excellent results and since there, no other studies was carried out. Therefore, our results lead to a new option in clinical routine to treat OSA, once AO_m usage may help to control /prevent cardiometabolic risk and rise the compliance to the treatment of OSA in people with DS.

Conclusions: The PSG results showed that the use of an OA_m to treat OSA is safe and effective for adult with DS with a high compliance, showing that adult with DS have no difficulties with the usage of the appliance. It seems to be a safe and viable treatment option to OSA which can be offered to adult with DS who do not tolerate or refuse CPAP therapy. Further studies with a larger number of patients should be carried out in order to confirm these results.

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ABSTRACT #023

COMPARISON OF POLYSOMNOGRAPHIC AND CEPHALOMETRIC PARAMETERS BETWEEN POSITIONAL AND RAPID EYE MOVEMENT DEPENDENT OBSTRUCTIVE SLEEP APNEAS

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Introduction: Patients with obstructive sleep apnea (OSA) usually have more obstructive events in the supine position than in the lateral position, and identifying OSA patients as being either positional or non-positional has been suggested as important therapeutic implications. But the anthropomorphic studies that have been reported regarding patient differences between, and risk factors for positional and non-positional OSA are few and conflicting. On the other hand, upper airway muscle activation is usually suppressed during rapid eye movement (REM) sleep than during non-rapid eye movement (NREM) sleep, resulting in the repeated episodes of sleep apnea and nocturnal episodic hypoxemia. REM-related OSA patients are defined as REM AHIs are higher than their NREM AHIs, and not-REM-related patients as REM AHIs are not significant different from their NREM AHIs. REM-related OSA is well recognized as a result of significant muscular hypotonia, but not-REM-related OSA is unexplored in its mechanism yet. So it needs to evaluate polysomnographic and cephalometric characteristics of the positional or REM dependent OSAs and to investigate the predictors for the treatment modalities. The aims of this study were to analyze the predisposing factors of OSA and anatomic features of upper airway structures and to compare the differences in polysomnographic and cephalometric parameters according to the positional and REM dependencies in patients with OSA.

Methods: One hundred thirty-three consecutive patients with OSA who visited Department of Oral Medicine, Seoul National University Dental Hospital were performed nocturnal polysomnography and cephalometric analyses. The subjects were categorized into positional (supine apnea-hypopnea index [AHI] $\geq$ 2 x lateral AHI) and non-positional (supine AHI < 2 x lateral AHI) OSA patients according to the positional dependency, and REM-related (REM AHI $\geq$ 2 x non-REM AHI) and not-REM-related (REM AHI < 2 x non-REM AHI) OSA patients according to the REM dependency.

Results: Non-positional and not-REM-related OSA patients showed significantly higher overall AHI, non-supine AHI, and NREM AHI and lower mean SpO_2, and NREM SpO_2 than positional and REM-related OSA patients, respectively. Non-positional patients showed significantly higher body mass index than positional patients. Not-REM-related patients were significantly older than REM-related patients. There were no significant differences in cephalometric parameters between positional and non-positional patients. However, not-REM-related patients showed significantly smaller inferior oral airway space and higher distances between anterior hyoid bone and mandibular plane, between posterior nasal spine and tip of uvula, and maximum width of soft palate than REM-related patients.

Conclusions: Our study suggests that non-positional and not-REM-related OSA patients have more collapsible airway patency than positional and REM-related OSA patients, respectively, and anatomical factors can affect REM dependency more than positional dependency on the severity of OSA.

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