Articles of the Month – March 2022

OSA

The impacts of ambient relative humidity and temperature on supine position-related obstructive sleep apnea in adults

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Obstructive sleep apnea (OSA) is associated with seasonal variations. The objective of this study was to examine associations of ambient relative humidity (RH) and temperature on sleep parameters. We conducted a cross-sectional study by retrospectively recruiting 5204 adults from a sleep center in Taipei, Taiwan. Associations of 1-night polysomnography with ambient RH and temperature in 1-day, 7-day, 1-month, 6-month, and 1-year averages were examined using linear regression models and a mediation analysis. RH increase was associated with snoring index decrease and apnea/hypopnea index (AHI) increase. Temperature increase was associated with decreases in sleep efficiency and the AHI, and increases in the wake time after sleep onset and snoring index. RH increase was inversely associated with non-rapid eye movement (NREM) sleep stage I (N1), III (N3), and rapid eye movement (REM) sleep, but positively associated with the NREM sleep stage II (N2) stage. Temperature increase was associated with N1, N2, and N3 sleep. An increase in RH was associated with an increase in the arousal index and a decrease in the < 95% arterial oxygen saturation (SaO_2) among total, REM, and NREM sleep, whereas a temperature increase was associated with a decrease in the arousal index and an increase in < 95% SaO_2 among total, REM, and NREM sleep. An increase in RH was associated with increases in the time spent in a supine posture and the supine AHI. An increase in temperature was associated with decreases in the supine posture, supine AHI, and non-supine AHI. The N3 sleep stage was an important mediator in increasing the supine AHI with a long-term increase in RH. But the N1 and N2 sleep stages mediated a decrease in the supine AHI with an increase in RH. In conclusion, ambient RH and temperature were associated with alterations in sleep parameters in adults, which were mediated by the sleep cycle. An understanding of outdoor environments has important implications for diagnostic classifications in the supine dominance of OSA in adults.

EADSM comment: Interesting findings about relationships between air humidity, temperature and sleep variables, including breathing disturbances.

Clinical Polysomnographic Methods for Estimating Pharyngeal Collapsibility in Obstructive Sleep Apnea

Daniel Vena [1], Luigi Taranto-Montemurro [1], Ali Azarbarzin [1], Sara Op de Beeck [2 3], Melania Marques [1 4], Olivier M Vanderveken [2 3 5], Bradley A Edwards [6 7], Laura Gell [1], Nicole Calianese [1], Lauren B Hess [1], Reza Radmand [1], Garun S Hamilton [8 9], Simon A Joosten [8 9], Johan Verbraecken [2 5], Marc Braem [2 10], David P White [1], Susan Redline [1], Scott A Sands [1], Andrew Wellman [1]

Study objectives: Obstructive sleep apnea has major health consequences but is challenging to treat. For many therapies, efficacy is determined by the severity of underlying pharyngeal collapsibility, yet there is no accepted clinical means to measure it. Here we provide insight into which polysomnographic surrogate measures of collapsibility are valid, applicable across the population, and predictive of therapeutic outcomes.

Methods: Seven promising polysomnography-derived surrogate collapsibility candidates were evaluated: Vpassive (flow at eupneic ventilatory drive), Vmin (ventilation at nadir drive), event depth (depth of the average respiratory event), oxygen desaturation slope and mean oxygen desaturation (events-related averages), Fhypopneas (fraction of events scored as hypopneas), and apnea index. Evaluation included 1) validation by comparison to physiological gold-standard collapsibility values (critical closing pressure, Pcrit), 2) capacity to detect increased collapsibility with older age, male sex, and obesity in a large community-based cohort (Multi-Ethnic Study of Atherosclerosis, MESA), and 3) prediction of treatment efficacy (oral appliances and pharmacological pharyngeal muscle stimulation using atomoxetine-plus-oxybutynin).

Results: Pcrit was significantly correlated with Vmin (r=-0.54), event depth (r=0.49), Vpassive (r=-0.38), Fhypopneas (r=-0.46), and apnea index (r=-0.46; all p<0.01) but not others. All measures detected greater collapsibility with male sex, age, and obesity, except Fhypopneas and apnea index which were not associated with obesity. Fhypopneas, and apnea index were associated with oral appliance and atomoxetine-plus-oxybutynin efficacy (both p<0.05).

Conclusions: Among several candidates, event depth, Fhypopneas, and apnea index were identified as a preferred pharyngeal collapsibility surrogates for use in the clinical arena.

*E*ADSM comment: A further step forward in diagnosing OSA.

MAD

Mandibular advancement device: prescription in adult dental sleep medicine - guideline of the German Society of Dental Sleep Medicine

Olaf Bernhardt [1], Nikolaos Nikitas Giannakopoulos [2][3], Markus Heise [4], Alexander Meyer [5], Dagmar Norden [6], Jörg Schlieper [7], Horst Kares [8]

Purpose: Obstructive sleep apnea (OSA) may result in severe health onditions, reduces quality of live, and affects high percentages of the adult population. Due to recent changes in the German health care regulations, mandibular advancement devices (MAD) will become available as a treatment option for OSA to a greater extent for general dentists and their patients.

Methods: A guideline development group consisting of nine members representing four German dental and medical organizations was formed, in order to provide critical information and orientation to the main stakeholders (dentists and patients), regarding the use of MAD for the treatment of OSA within dental sleep medicine.

Results: This guideline aims to inform physicians and dentists, particularly those with acquired qualification/specialization in sleep medicine (or in the diagnosis and treatment of sleep-related breathing disorders), as well as experts, payers, and patients. It delivers recommendations on technical requirements for MAD prescription and fabrication, clinical procedures, maintenance, and follow-up procedures.

Conclusion: A MAD should be designed for long-term therapy and must be a custom made, adjustable, bimaxillary retained two-splint system equipped with adjustable protrusive elements. The fabrication in a dental laboratory should be based on dental impressions or scans and three-dimensional registrations of the starting position taken with a bite gauge.

==EADSM== comment: New dental sleep medicine guideline, that will of interest for many readers.

JPD
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CLINICAL RESEARCH

Modified biblock versus monoblock mandibular advancement appliances for treatment of obstructive sleep apnea: A randomized controlled trial

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ABSTRACT

Statement of problem. The high prevalence of obstructive sleep apnea represents a serious public health problem. Oral appliances have gained wide acceptance among patients diagnosed with obstructive sleep apnea, who should wear them every night. A comfortable oral appliance is mandatory for successful treatment outcomes.

Purpose. The purpose of this randomized controlled trial was the assessment of the influence of 2 different designs of the mandibular advancement appliance (MAA), modified biblock and monoblock, for the management of obstructive sleep apnea.

Material and methods. The study was designed as a prospective 2-arm randomized controlled clinical trial conducted in parallel. Twenty participants (aged 40 ±7.5 years) diagnosed with moderate obstructive sleep apnea were randomly assigned to a control group (n=10), receiving monoblock MAA, and a study group (n=10), receiving modified biblock MAA with elastics. Both appliances were fabricated by using computer-aided design and computer-aided manufacture (CAD-CAM) technology at different mandibular advancement levels (MALs): 50% and 75% of maximum MAL. A total of 60 cone beam computed tomography scans, 60 overnight full polysomnography sleep tests, 60 STOP-Bang questionnaires, and 40 Usability of Sleep Apnea Equipment-Oral Appliance (USE-OA) questionnaires were collected and analyzed blindly at baseline (initial visit), 50% MAL (3 months), and 75% MAL (6 months). The main outcome measures were the upper airway volume, linear anteroposterior and cross-sectional airway measurements, Apnea Hypopnea Index, Respiratory Disturbance Index, STOP-Bang questionnaire scoring, and USE-OA questionnaire scoring. Nonparametric statistical analysis was performed by using a statistical software program (α=.05). With a beta error accepted of up to 20%, the power of the study was 80%.

Results. At 75% MAL, the percentage change in upper airway volumetric measurements showed a favorable increase: biblock group (115%) and monoblock group (42%), with a statistically significant difference (*P*=.001). The linear anteroposterior airway measurements and the percentage change in cross-sectional airway measurements were statistically similar: biblock group (80%) and (75%) monoblock group (60%), (54%) (*P*=.450, *P*=.151, respectively). The percentage change in the Apnea Hypopnea Index significantly decreased: biblock group (-89%) and monoblock group (-54%) (*P*<.001). The percentage change in the Respiratory Disturbance Index decreased: biblock group (-78%) and monoblock group (-62%) (*P*<.023). From the STOP-Bang questionnaire scoring, 100% of both groups showed low risk for obstructive sleep apnea at 75% MAL. From the satisfaction scoring on the USE-OA questionnaire, the biblock group was 100% strong satisfaction and the monoblock group was 50% satisfaction and 50% fairly satisfied.

Conclusions. The modified biblock MAA with elastics showed significant improvements in patients diagnosed with obstructive sleep apnea regarding upper airway measurements and full polysomnography vital parameters when compared with monoblock MAA. (J Prosthet Dent 2022;■:■-■)

EADSM comment: More studies regarding the efficacy of various designs of MADs are welcome, like this article.

Mouth Closing to Improve the Efficacy of Mandibular Advancement Devices in Sleep Apnea

Gonzalo Labarca [1], Scott A Sands [2], Vicki Cohn [3], Gail Demko [4], Daniel Vena [5], Ludovico Messineo [6], Laura Gell [2], Lauren Hess [7], David P White [8], Andrew Wellman [5], Ali Azarbarzin [2]

Rationale: Mouth breathing increases upper airway collapsibility, leading to decreased efficacy of obstructive sleep apnea (OSA) treatments. We hypothesized that the use of mandibular advancement devices (MAD) increases mouth breathing and, thus, using an adhesive mouthpiece (AMT), to prevent mouth breathing, in combination with MAD can improve the treatment efficacy.

Objectives: To evaluate the efficacy of MAD + AMT in comparison to MAD alone.

Methods: A prospective crossover pilot study was designed to test this hypothesis. Briefly, adult participants with an apnea-hypopnea index (AHI) between 10-50 events/h at the screening visit were randomized to no treatment (baseline), MAD treatment, AMT treatment, and MAD+AMT treatment. As a primary analysis, absolute AHI was compared between MAD and MAD + AMT arms. Secondary analyses included quantifying the percent change in AHI, percentage of complete (AHI < 5 events/h) and incomplete (AHI 5 - 10 events/h) responders, and the efficacy of AMT alone in comparison with other treatment arms.

Results: A total 21 of participants were included. (Baseline AHI= 24.3±9.9 event/h) The median AHI (Interquartile [IQR]) in the MAD and MAD+AMT arms were 10.5 [5.4-19.6] events/h and 5.6 [2.2-11.7] events/h (p-value= 0.02), respectively. A total of 76% of individuals achieved an AHI < 10 events/h in the MAD + AMT arm vs. 43% in the MAD arm (p-value<0.01). Finally, the observed effect was similar in moderate to severe OSA (AHI ≥15 events/h) in terms of absolute reduction and treatment responders, and AMT alone did not significantly reduce the AHI compared to baseline.

Conclusion: Combination of an adhesive mouthpiece and MAD is a more effective therapy than MAD alone. These findings may help improve clinical decision-making in sleep apnea.

EADSM comment: Another step forward in the identification of a "golden standard MAD". Although, to totally prevent from mouth breathing might be difficult for patients with nasal congestion.

Continuous Positive Airway Pressure vs Mandibular Advancement Devices in the Treatment of Obstructive Sleep Apnea: An Updated Systematic Review and Meta-Analysis

Meghana Pattipati[1], Goutham Gudavalli[2], Matthew Zin[1], Lohitha Dhulipalla[3], Essasani Kolack[1], Monika Karki[1], Pradeep Kumar Devarakonda[1], Linus Yoe[1]

Introduction: Obstructive sleep apnea (OSA) is the most common sleep-related breathing disorder which has various treatment options, however, continuous positive airway pressure (CPAP) remains the gold standard. The aim of this meta-analysis is to compare the current first-line treatment of OSA, i.e., the continuous positive airway pressure (CPAP) with mandibular advancement devices (MADs) in mild to severe OSA.

Objective: This meta-analysis is a comparison of the efficacy of continuous positive airway pressure vs mandibular advancement devices in patients with mild to severe obstructive sleep apnea. The primary objective of the meta-analysis is to compare the efficacy of CPAP vs MADs in the treatment of OSA. This meta-analysis includes randomized control and cross-over studies that compare the efficacy of CPAP and MAD and outcomes are reported in terms of apnea-hypopnea index (AHI), lowest oxygen saturation, and Epworth sleepiness scale both pre- and post-treatment.

Data sources and study selection: A PubMed and Cochrane database search was conducted in May 2021 and study bibliographies were reviewed. Randomized clinical trials comparing the effect of CPAP and MAD on AHI, lowest oxygen saturation, and ESS in patients with obstructive sleep apnea were selected. Of the 436 studies initially identified, eight were selected for analysis after screening. The quantitative measures used for comparing the efficacy of CPAP and MAD were post-treatment apnea-hypopnea index (AHI), lowest oxygen saturation, and post-treatment Epworth score scale (ESS).

Data extraction and synthesis: A network of meta-analyses was performed using RevMan (Copenhagen, Denmark: Nordic Cochrane Center) where multivariate random-effects models were used to generate pooled estimates. Data were analyzed using generic inverse variance method and P < 0.05 is regarded as statistically significant. Combined summary statistics of standardized (STD) paired difference in mean for individual studies and combined studies was calculated. A chi-square-

based test of homogeneity was performed and the inconsistency index (I²) statistic was determined.

Results: Compared the AHI, lowest oxygen saturation, and ESS from baseline to follow-up pre- and post-treatment in both CPAP and MAD groups; after the database search 436 records were identified, eight studies were included in the RCT, and three were RCT crossover studies. The duration of treatment varies in each group. AHI, ESS, and lowest oxygen saturation are calculated pre- and post-treatment. Compared with MAD, CPAP was associated with decrease in AHI with a mean difference of -5.83 (95% CI, -8.85, -2.81, P < 0.01). The lowest oxygen saturation was also decreased in CPAP group compared to MAD group with a mean difference of 0.72 (95% CI, 0.51, 0.94, P < 0.01). However, there was no statistically significant difference in ESS between CPAP and MAD group with a mean difference of 0.23 (95% CI, -0.24, 0.70, P = 0.34). The meta-analysis states that among patients with obstructive sleep apnea, both CPAP and MADs are effective in reducing the AHI and lowest oxygen saturation, however, no significant difference was found in ESS pre- and post-treatment.

Conclusions: CPAP still remains the gold standard for the treatment of OSA and should continue to be recommended as a treatment for OSA. MAD can be used as adjunctive treatment or as a treatment for those who cannot readily access or do not prefer CPAP.

EADSM comment: Always interesting with new meta-analyses, although not much new in this area.

Disparities in oxygen saturation and hypoxic burden levels in obstructive sleep apnoea patient's response to oral appliance treatment

Ji Woon Park [1][2][3], Fernanda R Almeida [1]

Background: Oxygen saturation indices show a strong correlation with long-term health outcomes. Nonetheless, evidence on the relationship between reduction in respiratory events and increase in oxygenation levels following oral appliance (OA) treatment is scarce.

Objectives: To verify the relationship between reduction in the apnoea-hypopnoea index (AHI) and oxygen saturation levels following OA treatment, we have conducted an evaluation of polysomnography (PSG) and clinical parameters associated with the improvement of oxygen desaturation.

Methods: OSA patients (n = 48) who received an OA and had pre- and post-treatment PSG were classified into three responder groups according to the change in AHI and min O_2 post-treatment: responder$_{AHIonly}$ (decrease in AHI of ≥50% but increase in min O_2 level of <4% or decrease); responder$_{MinO2only}$ (increase in min O_2 level of ≥4% but decrease in AHI <50% or increase) and responder$_{Congruous}$ (decrease in AHI of ≥50% and increase in min O_2 level of ≥4%). Various demographic and PSG variables were statistically compared among groups.

Results: There were 26 (54.17%) responder$_{AHIonly}$, 9 (18.75%) responder$_{MinO2only}$ and 13 (27.08%) responder$_{Congruous}$. Pre-treatment min O_2 was significantly lower in responder$_{MinO2only}$. A higher pre-treatment min O_2 showed a significant correlation with a smaller amount of change in mean O_2 (r = -.486) and min O_2 (r = -.764) with treatment. Pre-treatment min O_2 showed the strongest ability to predict those who would show a ≥4% min O_2 increase following treatment.

Conclusion: Certain patients do not show sufficient decrease in hypoxaemia in spite of the improvement in AHI. Pre-treatment min O_2 should be considered in OA treatment planning regarding its close relation to improvements in oxygenation levels with treatment.

==EADSM comment==: Interesting new way of identifying success with MAD

Dental and Skeletal Side Effects of Oral Appliances Used for the Treatment of Obstructive Sleep Apnea and Snoring in Adult Patients-A Systematic Review and Meta-Analysis

Ioannis A Tsolakis [1], Juan Martin Palomo [2], Stefanos Matthaios [2], Apostolos I Tsolakis [3]

Background: Mandibular advancement devices for obstructive sleep apnea treatment are becoming increasingly popular among patients who do not prefer CPAP devices or surgery. Our study aims to evaluate the literature regarding potential dental and skeletal side effects caused by mandibular advancement appliances used for adult OSA treatment.

Methods: Electronic databases were searched for published and unpublished literature along with the reference lists of the eligible studies. Randomized clinical trials and non-randomized trials assessing dental and skeletal changes by comparing cephalometric radiographs were selected. Study selection, data extraction, and risk of bias assessment were performed individually and in duplicate. Fourteen articles were finally selected (two randomized clinical trials and 12 non-randomized trials).

Results: The results suggest that mandibular advancement devices used for OSA treatment increase the lower incisor proclination by 1.54 ± 0.16°, decrease overjet by 0.89 ± 0.04 mm and overbite by 0.68 ± 0.04 mm, rotate the mandible downward and forward, and increase the SNA angle by to 0.06 ± 0.03°. The meta-analysis revealed high statistical heterogeneity.

Conclusions: The MADs affect the lower incisor proclination, overjet, overbite, the rotation of the mandible and the SNA angle. More randomized clinical trials providing high-quality evidence are needed to support those findings.

EADSM comment: Well-known side-effects from MADs that needs more consideration.

Oral appliance therapy for obstructive sleep apnea in multiple system atrophy with floppy epiglottis: a case series of three patients

Toshihiko Mikami [1][2], Tadaharu Kobayashi [3], Daichi Hasebe [3], Yasuyoshi Ohshima [4], Tetsuya Takahashi [5], Takayoshi Shimohata [6]

Purpose: A recent study demonstrated that continuous positive airway pressure (CPAP) may exacerbate obstructive sleep apnea (OSA) in patients with multiple system atrophy (MSA) and a floppy epiglottis (FE) as the CPAP promotes downward displacement of the epiglottis into the laryngeal inlet. In this case series, we examined the effectiveness of an oral appliance (OA) for treating OSA in three patients with MSA and an FE.

Methods: Patients with MSA were demonstrated to have an FE on fiberoptic laryngoscopy under sedation using intravenous propofol. The therapeutic intervention was fitting an OA. Polysomnography (PSG) was performed subsequently with the OA in place.

Results: In three patients with MSA, some parameters used to assess the severity of OSA improved with an OA. Both apnea-hypopnea index (AHI) and arousal index (ArI) decreased while wearing the OA in two cases while in the third case, apnea index (AI) and cumulative time at peripheral oxygen saturation (SpO_2) below 90% (CT90) decreased, but AHI and ArI increased. The only side effects were transient TMJ discomfort, masseter muscle pain, and tooth discomfort.

Conclusion: OA therapy using a two-piece type mandibular advancement device (MAD) may be a useful treatment intervention for patients with OSA who have MSA and FE.

EADSM comment: Further proof for the indications for MADs for patients with epiglottic collapse, when PAP also might fail.

Improvement of obstructive sleep apnea in a child with Down syndrome with rapid palatal expansion

Ahhyeon Kim [1], Hyung-Ju Cho [2], Eun Kyoung Choi [3], Yoon Jeong Choi [1]

Children with Down syndrome (DS) have distinct orofacial structures that predispose them to sleep-disordered breathing. The management options for obstructive sleep apnea (OSA) include continuous positive airway pressure, adenotonsillectomy, mandibular advancement, and maxillary expansion. However, most of these treatment options are less effective or less viable for children with DS. Rapid maxillary expansion (RPE) with a fixed orthodontic appliance is a viable alternative for DS patients because it separates the mid-palatal suture and dilates the airway, regardless of the patient's adherence. We present a case of a 15-year-old boy with DS and severe OSA, which dramatically improved with RPE and subsequent orthodontic treatment. Although only the short-term changes have been presented in this report, this case emphasizes the need for further discussions on the viability of RPE for treating OSA in children with DS.

EADSM comment: As mentioned in earlier literature reviews, pediatric OSA is a neglected area.