Articles of the Month – April 2022

OSA – DIAGNOSIS

Front Neurosci. 2022 Mar 15;16:726880.
doi: 10.3389/fnins.2022.726880. eCollection 2022.
Link: https://www.frontiersin.org/articles/10.3389/fnins.2022.726880/full

Diagnosis of Sleep Apnoea Using a Mandibular Monitor and Machine Learning Analysis: One-Night Agreement Compared to in-Home Polysomnography

Julia L Kelly[1], Raoua Ben Messaoud[2], Marie Joyeux-Faure[2 3], Robin Terrail[2 3], Renaud Tamisier[2 3], Jean-Benoît Martinot[4 5], Nhat-Nam Le-Dong[6], Mary J Morrell[1], Jean-Louis Pépin[2 3]

Background: The capacity to diagnose obstructive sleep apnoea (OSA) must be expanded to meet an estimated disease burden of nearly one billion people worldwide. Validated alternatives to the gold standard polysomnography (PSG) will improve access to testing and treatment. This study aimed to evaluate the diagnosis of OSA, using measurements of mandibular movement (MM) combined with automated machine learning analysis, compared to in-home PSG.
Methods: 40 suspected OSA patients underwent single overnight in-home sleep testing with PSG (Nox A1, ResMed, Australia) and simultaneous MM monitoring (Sunrise, Sunrise SA, Belgium). PSG recordings were manually analysed by two expert sleep centres (Grenoble and London); MM analysis was automated. The Obstructive Respiratory Disturbance Index calculated from the MM monitoring (MM-ORDI) was compared to the PSG (PSG-ORDI) using intraclass correlation coefficient and Bland-Altman analysis. Receiver operating characteristic curves (ROC) were constructed to optimise the diagnostic performance of the MM monitor at different PSG-ORDI thresholds (5, 15, and 30 events/hour).
Results: 31 patients were included in the analysis (58% men; mean (SD) age: 48 (15) years; BMI: 30.4 (7.6) kg/m^2). Good agreement was observed between MM-ORDI and PSG-ORDI (median bias 0.00; 95% CI -23.25 to + 9.73 events/hour). However, for 15 patients with no or mild OSA, MM monitoring overestimated disease severity (PSG-ORDI < 5: MM-ORDI mean overestimation + 5.58 (95% CI + 2.03 to + 7.46) events/hour; PSG-ORDI > 5-15: MM-ORDI overestimation + 3.70 (95% CI -0.53 to + 18.32) events/hour). In 16 patients with moderate-severe OSA (*n* = 9 with PSG-ORDI 15-30 events/h and *n* = 7 with a PSG-ORD > 30 events/h), there was an underestimation (PSG-ORDI > 15: MM-ORDI underestimation -8.70 (95% CI -28.46 to + 4.01) events/hour). ROC optimal cut-off values for PSG-ORDI thresholds of 5, 15, 30 events/hour were: 9.53, 12.65 and 24.81 events/hour, respectively. These cut-off values yielded a sensitivity of 88, 100 and 79%, and a specificity of 100, 75, 96%. The positive predictive values were: 100, 80, 95% and the negative predictive values 89, 100, 82%, respectively.
Conclusion: The diagnosis of OSA, using MM with machine learning analysis, is comparable to manually scored in-home PSG. Therefore, this novel monitor could be a convenient diagnostic tool that can easily be used in the patients' own home.

EADSM comment: New simplified methods to diagnose OSA are welcome.

Front Med (Lausanne). 2022 Mar 9;9:842224.
doi: 10.3389/fmed.2022.842224. eCollection 2022.

Link: https://www.frontiersin.org/articles/10.3389/fmed.2022.842224/full

Memory Foam Pillow as an Intervention in Obstructive Sleep Apnea Syndrome: A Preliminary Randomized Study

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Specific pillow use is a seldom studied or controlled factor in the setting of sleep disordered breathing. The aim of this study was to investigate the effect of different pillows [own pillow (OP), memory foam pillow (MFP), generic laboratory pillow (LP)] on polysomnography (PSG)-derived parameters in patients with Obstructive Sleep Apnea Syndrome (OSAS). Thirty-two consecutive patients with OSAS were randomly allocated into two groups with randomized pillow usage [Group A: 3 h with LP and 3 h with OP (Age: 53.8 ± 12.5 years, BMI: 32.1 ± 4.6 kg/m^2); Group B: 3 h with LP and 3 h with MFP (Age: 52.0 ± 6.3 years, BMI: 30.6 ± 2.2 kg/m^2)]. Statistically significant differences between pillow types were detected in desaturation index and heart rate. In Group B (with MFP), a statistically significant decrease of 47.0 ± 15.9% was observed in snoring events ($p < 0.05$) and 10.6 ± 6.7% in their duration ($p < 0.05$) compared to LP. On the other hand, group A with OP recorded a decrease of 29.1 ± 32.1% in snoring events and 32.5 ± 33.1% in duration, but these values were not statistically significant ($p > 0.05$) compared to LP. These findings indicate that pillow type and usage, often uncontrolled in OSAS studies (contribution to the field), may impact several PSG parameters and are related to a snoring subtype of the syndrome. Secondly, they indicate that a focus on the treatment of the snoring OSAS subtype warrants further dedicated investigation.

EADSM comment: Interesting study highlighting a forgotten issue, the influence of the pillow on the results of the sleep recording, which may significantly influence comparisons.

JMIR Form Res. 2022 Apr 6;6(4):e30102.
doi: 10.2196/30102.

Link: https://formative.jmir.org/2022/4/e30102/PDF

Sleeping in an Inclined Position to Reduce Snoring and Improve Sleep: In-home Product Intervention Study

Sharon Danoff-Burg[1], Holly M Rus[1], Morgan A Weaver[1], Roy J E M Raymann[1]

Background: Accurately and unobtrusively testing the effects of snoring and sleep interventions at home has become possible with recent advances in digital measurement technologies.

Objective: The aim of this study was to examine the effectiveness of using an adjustable bed base to sleep with the upper body in an inclined position to reduce snoring and improve sleep, measured at home using commercially available trackers.

Methods: Self-reported snorers (N=25) monitored their snoring and sleep nightly and completed questionnaires daily for 8 weeks. They slept flat for the first 4 weeks, then used an adjustable bed base to sleep with the upper body at a 12-degree incline for the next 4 weeks.

Results: Over 1000 nights of data were analyzed. Objective snoring data showed a 7% relative reduction in snoring duration (P=.001) in the inclined position. Objective sleep data showed 4% fewer awakenings (P=.04) and a 5% increase in the proportion of time spent in deep sleep (P=.02) in the inclined position. Consistent with these objective findings, snoring and sleep measured by self-report improved.

Conclusions: New measurement technologies allow intervention studies to be conducted in the comfort of research participants' own bedrooms. This study showed that sleeping at an incline has potential as a nonobtrusive means of reducing snoring and improving sleep in a nonclinical snoring population.

EADSM comment: The inclination of the bed might also influence sleep disordered breathing, as previously also pointed out and might also be used as a therapy for some patients.

OSA - MAD

Sleep Sci Apr-Jun 2022;15(Spec 2):300-305.
doi: 10.5935/1984-0063.20210006.

Link: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8906384/

Correlation between duration of edentulism and severity of obstructive sleep apnea in elderly edentulous patients

Arvind Tripathi[1], Ashutosh Gupta[1], Praveen Rai[1], Piyush Sharma[2], Suryakant Tripathi[1]

Objectives: To investigate the correlation between duration of edentulism and severity of obstructive sleep apnea in elderly edentulous patients.

Material and methods: 1,017 patients aged 55-65 years, with a history of edentulism of 12-60 months were screened. Detailed history of tooth loss and period of edentulism was recorded for the 414 patients who tested positive for OSA (obstructive sleep apnea). Complete dentures were prepared for each patient and they were trained to use the dentures as a mandibular advancement device (MAD) during sleep at night. Apnea-hypopnea index (AHI) data at pre-treatment, six months and one-year post-treatment time intervals was recorded. A correlation between the period of untreated edentulism and severity of OSA and improvement post-treatment was derived in this study.

Results: Mean duration of edentulism was 12.14±2.57 months and mean AHI was 16.62±13.24. For every three month increase in the duration of edentulism (after initial 6 months of total tooth loss), there was a statistically significant increase in severity of OSA. Patients who are edentulous for more than 15 months are increasingly vulnerable to OSA.

Discussion: Severity of OSA in afflicted long-term edentulous patients was in direct relation to the period of untreated edentulism and regressed likewise with concomitant denture wear and mandibular advancement during sleep at night. Early prosthetic rehabilitation of edentulous patients is imperative to obviate morbidity of OSA.

EADSM comment: The influence of edentulism has been discussed previously, mainly in terms of the benefits of conventional denture use or not. This article describes the consequences of edentoulism itself and the benefits of a denture-MAD for this group of patients. Although a causal relationship between tooth loss and OSA is difficult to prove, a prosthetic rehabilitation including MAD has many positive dimensions.

MAD

Nat Sci Sleep. 2022 Mar 25;14:517-529. doi: 10.2147/NSS.S351027. eCollection 2022.
Link: NSS_A_351027 517..529 (nih.gov)

Prediction of Mandibular Advancement Device Response Using CPAP Pressure in Different Polysomnographic Phenotypes

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Objective: Both continuous positive airway pressure (CPAP) pressure and polysomnographic phenotypes have been associated with mandibular advancement device (MAD) treatment response, but the precise relationship has not been fully elucidated. We hypothesized that utilizing CPAP pressure would predict the MAD response in treatment-naïve patients with moderate-severe obstructive sleep apnea (OSA), and the MAD response would be associated with two polysomnographic phenotypes, including sleep stage dependency and positional dependency.
Methods: OSA treatment-naïve patients with an apnea-hypopnea index (AHI) ≥15/h who declined CPAP treatment and received MAD treatment for 3-6 months were enrolled. The MAD treatment response was defined as 1) residual AHI under MAD (AHI_{MAD}) <5/h and 2) AHI_{MAD} <10/h. Logistic regression was applied to identify the association between CPAP pressure and MAD treatment responders. The predictability of the MAD responder status utilizing CPAP pressure was assessed with the area under the receiver operating characteristic (AUROC).
Results: A total of 128 enrolled patients (AHI ≥30/h in 74.2%) were recruited, of whom 119 patients and 80 patients were included for analysis of sleep stage and positional dependency, respectively. REM-predominant OSA had lower AHI than stage-independent OSA, while the supine-predominant phenotype had lower anthropometrics than the nonpositional-dependent phenotype. The response rates for AHI_{MAD} <5/h and AHI_{MAD} <10/h were 25.8% and 48.4%, respectively. Lower anthropometrics, baseline AHI, and supine predominance were associated with the responder status, while CPAP pressure was an independent predictor. The AUROCs for the prediction of AHI_{MAD} <5/h and AHI_{MAD} <10/h responders were 0.635 and 0.664, respectively. Utilizing a CPAP level >14 cmH_2O as the cutoff to predict criterion 1 and 2 nonresponders, the sensitivity was 93.9% and 95.2%, respectively.
Conclusion: In treatment-naïve patients with moderate-severe OSA, the supine-predominant phenotype and lower CPAP pressure were associated with the MAD response, while the sleep stage dependency phenotype was not. Utilization of a CPAP level >14 cmH_2O could be a sensitive measure to identify nonresponders.

EADSM comment: Article evaluating predictors of MAD therapy supports previous predictors of success; a low CPAP pressure and supine-dependent OSA. A monobloc device was used, which in previous prediction studies primarily have been used in those who found this association. Studies that used devices that allow mouth opening have shown inconsistent results.

Sleep Sci. Apr-Jun 2022;15(Spec 2):398-405.
doi: 10.5935/1984-0063.20210032.

Link: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8906377/

Mandibular advancement devices in obstructive sleep apnea: an updated review

Izabella Paola Manetta[1], Dominik Ettlin[2,3], Pedro Mayoral Sanz[4], Isabel Rocha[5], Miguel Meira E Cruz[6,7,8]

Obstructive sleep apnea (OSA) is the most prevalent sleep-disordered breathing in the adult population and if untreated remains a significant cause of morbidity and mortality. Continuous positive airway pressure (CPAP) therapy is still the gold standard treatment for OSA, but patient acceptance and adherence are often poor due to a multitude of factors, thereby compromising treatment success. Mandibular advancement devices (MADs) have been proposed not only as a first line therapy for symptomatic snoring patients, but also for those suffering from mild to moderate OSA, or those who refuse or do not tolerate CPAP. Yet, improved understanding of MAD regarding design, construction, and mechanisms of action is an important requirement to successfully implement MAD as a therapeutic tool. Therefore, the main focus of this paper is to focus on the general concepts and mechanisms of action of MAD, while highlighting important characteristics in the context of their use as a viable and effective treatment option for OSA patients.

EADSM comment: Nice overview of MAD therapy.

Consequences of untreated OSA

J Breast Cancer. 2022 Mar 10.
doi: 10.4048/jbc.2022.25.e11. Online ahead of print.

Link: https://ejbc.kr/pdf/10.4048/jbc.2022.25.e11

The Association of Obstructive Sleep Apnea With Breast Cancer Incidence and Mortality: A Systematic Review and Meta-analysis

Dominic Wei Ting Yap[#1], Nicole Kye Wen Tan[#1], Benjamin Kye Jyn Tan[1], Yao Hao Teo[1], Veronique Kiak Mien Tan[2,3,4], Anna See[5], Song Tar Toh[1,5,6,7]

Purpose: Emerging evidence from animal models suggests that intermittent hypoxia due to obstructive sleep apnea (OSA) is a risk factor for breast cancer. Despite their biological plausibility, human epidemiological studies have reported conflicting results. Therefore, we conducted a meta-analysis to delineate this relationship.
Methods: We searched the PubMed, Embase, Scopus, and Cochrane Library databases for eligible studies from inception until June 6, 2021. Two reviewers selected randomized trials or observational studies reporting the association between OSA and breast cancer incidence compared with those without OSA. Two reviewers extracted relevant data and assessed the quality of evidence using the Grading of Recommendations Assessment, Development, and Evaluation (GRADE) framework and Newcastle-Ottawa Scale (NOS). We pooled the maximally covariate-adjusted hazard ratios (HRs) using a random-effects inverse variance-weighted meta-analysis and performed pre-specified subgroup analyses.
Results: We included six studies out of 1,707 records, comprising a combined cohort of 5,165,200 patients. All studies used the International Classification of Diseases codes to classify OSA and breast cancer. OSA patients had a 36% increased breast cancer risk (HR, 1.36; 95% confidence interval [CI], 1.03-1.80; N = 6, I^2 = 96%) compared to those without OSA. Most studies adjusted for confounders, such as age, sex, obesity, diabetes mellitus, alcohol use, and hypertension. Subgroup analyses for studies with (1) multivariate adjustment and (2) at least five years of follow-up yielded HRs of 1.35 (95% CI, 0.98-1.87; N = 5, I^2 = 96%) and 1.57 (95% CI, 1.14-2.18; N = 4; I^2 = 90%), respectively. One Mendelian randomization study suggested a causal relationship, with a two-fold increase in the odds of breast cancer in patients with OSA.
Conclusion: This meta-analysis suggested that OSA is a risk factor for breast cancer. Future studies should explore the dose-response relationship between OSA and breast cancer, and whether treatment may mitigate breast cancer risk or progression.

EADSM comment: New insights on the relationship between OSA and cancer.

Pediatric OSA

Sleep Med. 2022 Apr;92:96-102.
doi: 10.1016/j.sleep.2022.02.011. Epub 2022 Feb 19.

Link:
https://reader.elsevier.com/reader/sd/pii/S1389945722000557?token=9194CDDE1266D96C3A8E223D932C8F5199C8E049D8912C00D90F7E7BEF40836733A58B53363CCCFCCED6AC8DF99BC619&originRegion=eu-west-1&originCreation=20220503122515

Impact of rapid palatal expansion on the size of adenoids and tonsils in children

Audrey Yoon[1], Mohamed Abdelwahab[2], Rebecca Bockow[3], Ava Vakili[4], Katherine Lovell[4], Inwon Chang[5], Rumpa Ganguly[6], Stanley Yung-Chuan Liu[2], Clete Kushida[1], Christine Hong[7]

Introduction: Adenoid and tonsillar hypertrophy in children often leads to adverse respiratory symptoms and obstructive sleep apnea (OSA). Current clinical guidelines from the American Academy of Pediatrics and American Academy of Otolaryngology-Head and Neck Surgery recommend tonsillectomy as the first line of pediatric OSA treatment for children with tonsillar hypertrophy. Rapid palatal expansion (RPE) performed by orthodontists improves obstructive sleep apnea in children by reducing nasal airway resistance, increasing nasal volume, raising tongue posture, and enlarging pharyngeal airway. However, the role of RPE in alleviating adenoid and tonsillar hypertrophy remains elusive. In this study, we aim to evaluate the changes in adenoid and palatine tonsil sizes following RPE using 3D volumetric analysis of cone beam computational tomography (CBCT) imaging.

Materials and methods: In this retrospective cohort study, a total of 60 pediatric patients (mean age: 8.00, range: 5-15, 32 females and 28 males) who had tonsillar hypertrophy (size 3 and 4) were included and divided into the control group (n = 20) and expansion group (n = 40). The control group did not undergo any treatment. The expansion group underwent RPE using a conventional Hyrax expander, activated 0.25 mm per day for 4-6 weeks. Final CBCT scans (T2) were performed 13.8 ± 6.5 months after the initial scan (T1). Pediatric sleep questionnaire (PSQ) and BMI were obtained at each timepoint. Volumetric analysis of adenoid and palatine tonsils was performed using a combination of bony and soft tissue landmarks in CBCT scans through Anatomage Invivo 6 imaging software. Paired t-tests were used to evaluate the difference between the initial and final adenoid and tonsil volumes. p values less than 0.05 were considered statistically significant.

Results: Compared to the control group, the expansion group experienced a statistically significant decrease in both adenoid and tonsil volume. There was non-statistically significant increase in volume from T1 to T2 for the control group. For the expansion group, 90.0% and 97.5% of patients experienced significant reduction in adenoid and tonsil volume, respectively. The average volume decrease of adenoids was 16.8% while that of tonsils was 38.5%. The patients had up to 51.6% and 75.4% reduction in adenoid and tonsil size,

respectively, following RPE orthodontic treatment. Pearson correlation ranged from 0.88 to 0.99 for each measurement, representing excellent internal consistency. There was a significant reduction in the PSQ scores from 5.81 ± 3.31 to 3.75 ± 2.38 in expansion group ($p < 0.001$).

Conclusions: Our results demonstrated that RPE significantly reduced the size of both adenoid and palatine tonsils and revealed another long-term benefit of RPE treatment. To our knowledge, this is the first study to quantify the changes of adenoids and tonsils following RPE. RPE treatment can be considered as a valid and effective treatment option for pediatric OSA population with narrow high arch palate and adenotonsillar hypertrophy.

EADSM comment: It has previously been observed that tonsil size may diminish during RPE. This study shows further proof for this theory.

Review

Sleep Med Rev. 2022 Mar 31;63:101629.

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Link:
https://reader.elsevier.com/reader/sd/pii/S1087079222000429?token=69EC96558AF463B2FDB8014797F988770EBA2874C278C33B6315333ABB94C805B871A9C51430468B21994C7CCE246A2A&originRegion=eu-west-1&originCreation=20220503124128

Neurocognitive outcomes of children with sleep disordered breathing: A systematic review with meta-analysis

Bethanie Menzies[1], Arthur Teng[2], Mary Burns[3], Suncica Lah[3]

Children with sleep disordered breathing (SDB) are at an increased risk of neurocognitive impairments. This systematic review with meta-analysis aims to 1) establish whether SDB differentially impacts various neurocognitive domains (intelligence, attention/executive functions, memory, visual spatial skills, and language) and 2) examine the effects of several moderating factors. Database searches, conducted according to the PRISMA guidelines, identified 77 studies that met pre-determined criteria, 63 of which were included in the meta-analysis. Most studies were of moderate to high quality. Children with SDB had significant impairments in all cognitive domains, albeit of different magnitude. The largest impairments were found in intelligence (verbal and overall). With respect to severity of SDB, neurocognitive deficits were evident in children with primary snoring (PS) as well as in children with obstructive sleep apnea (OSA). Other moderators: higher body mass index, younger age at testing, using questionnaires rather than polysomnography, and employing a control group instead of normative data, related to poorer neurocognitive outcomes in select domains. Overall, our study provides robust evidence of multiple neurocognitive impairments in children with SDB, with no evidence of sparing in children with PS. The findings of our study provide impetus for research and interventions for children with SDB across all severities.

EADSM comment: Important data that both children with primary snoring and those with OSA might suffer from neurocognitive impairment.