Articles of the Month – February 2023

MAD

Physiol Rep. 2023 Feb;11(3):e15558.

 doi: 10.14814/phy2.15558.

Link: https://physoc.onlinelibrary.wiley.com/doi/10.14814/phy2.15558

**Mandibular advancement reduces pharyngeal collapsibility by enlarging the airway rather than affecting velopharyngeal compliance**

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Mandibular advancement devices (MADs) are frequently prescribed for obstructive sleep apnea (OSA) patients, but approximately one third of patients experience no therapeutic benefit. Understanding the mechanisms by which MADs prevent pharyngeal collapse may help optimize MAD therapy. This study quantified the relative contributions of changes in airspace cross-sectional area (CSA) versus changes in velopharyngeal compliance in determining MAD efficacy. Sixteen patients with moderate to severe OSA (mean apnea-hypopnea index of 32 ± 15 events/h) underwent measurements of the velopharyngeal closing pressure (PCLOSE ) during drug induced sedated endoscopy (DISE) via stepwise reductions in nasal mask pressure and recording of the intraluminal pressure with a catheter. Airspace CSA was estimated from video endoscopy. Pharyngeal compliance was defined as the slope of the area-pressure relationship of the velopharyngeal airspace. MAD therapy reduced PCLOSE from a median of 0.5 cmH2 O pre-advancement to a median of -2.6 cmH2 O post-advancement (p = 0.0009), increased the minimal CSA at the velopharynx by approximately 20 mm2 (p = 0.0067), but did not have a statistically significant effect on velopharyngeal compliance (p = 0.23). PCLOSE had a strong correlation with CSA but did not correlate with velopharyngeal compliance. Our results suggest that MADs reduce velopharyngeal collapsibility by increasing airway size as opposed to affecting velopharyngeal compliance. This contradicts the speculation of previous literature that the effectiveness of MADs is partially due to a reduction in velopharyngeal compliance resulting from stretching of the soft palate. These findings suggest that quantification of velopharyngeal CSA pre- and post-MAD advancement has potential as a biomarker to predict the success of MAD therapy.

*EADSM* comment: Interesting study elucidating the mechanism of mandibular advancement on pharyngeal patency, where they find that the device primarily act by widen the upper airway than stiffening the structures.

J Oral Rehabil. 2023 Feb 16.

 doi: 10.1111/joor.13433. Online ahead of print.

Link: https://onlinelibrary.wiley.com/doi/epdf/10.1111/joor.13433

# The Effects of Mandibular Advancement Appliance Therapy on Jaw-Closing Muscle Activity Time-Related to oxygen desaturations: A Randomized Controlled Trial

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**Background:**Previous study showed that in individuals with obstructive sleep apnea (OSA), the contractions of masseter muscles after respiratory events can be nonspecific motor phenomena, dependent on the duration of respiratory arousals rather than the occurrence of the respiratory events. However, the role of intermittent hypoxia in the occurrence of jaw-closing muscle activities (JCMAs) was not taken into consideration. An exposure to intermittent hypoxia has been shown to initiate a series of activities, including muscular sympathetic activity in patients with OSA.

**Objective:**To determine the effects of mandibular advancement appliance (MAA) therapy on JCMA time-related to oxygen desaturation with and without arousal in individuals with OSA.

**Methods:**Eighteen individuals with OSA (age: 49.4 ± 9.8 years, apnea-hypopnea index (AHI): 10.0|18.4|30.3, JCMA index: 1.7|4.3|5.6), participated in a randomized controlled crossover clinical trial, in which two ambulatory polysomnographic recordings were performed: one with MAA in situ and the other without MAA in situ. JCMAs were recorded bilaterally from both masseter and temporalis muscles.

**Results:**There was no significant effect of the MAA on the overall JCMA index (Z = -1.372, P = 0.170). With the MAA in situ, JCMA index time-related to oxygen desaturation with arousal significantly decreased (Z = -2.657, P = 0.008), while there was no significant effect of the MAA on the JCMA index time-related to oxygen desaturation without arousal (Z = -0.680, P = 0.496).

**Conclusion:**Effective mandibular advancement appliance therapy significantly reduces jaw-closing muscle activities time-related to oxygen desaturation with arousal in individuals with OSA.

*EADSM* comment: This study shows that MAD reduces jaw closing activity, related to oxygen desaturations. This is in line with early studies showing that the masseter muscle activates with inspiratory resistance loading (Hollowell, D.E. and Suratt, P.M. 1989, Hollowell, D.E. and Suratt, P.M. 1991), thus improving the airway patency. But, more studies have also been published in this topic since then.

OSA

Eur Arch Otorhinolaryngol. 2023 Feb 4.

 doi: 10.1007/s00405-023-07860-x. Online ahead of print.

Link: file:///C:/Users/mama0004/Downloads/s00405-023-07860-x.pdf

# The effect of head rotation on OSA is associated with disease severity: a cross-sectional study

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**Purpose:**Head rotation is an effective positional therapy for obstructive sleep apnea (OSA). However, not all OSA patients benefit from head rotation. This study aimed to explore the clinical phenotype of OSA patients who can benefit from head rotation.

**Methods:**We performed a retrospective review of 184 consecutive OSA patients who underwent polysomnography. Head rotation in supine position was determined by high-quality video recording. According to the changes in apnea-hypopnea index (AHI) after head rotation, OSA patients were divided into two groups: patients with response to head rotation(HR) and patients without response to head rotation(NHR). Demographic factors and overnight polysomnography were analyzed.

**Results:**Compared with NHR group, HR group showed significantly lower AHI (51.8 vs 31.5, p < 0.01), time spent with oxygen saturation below 90%(5.3% vs 0.51%, p < 0.01), and higher lowest oxygen saturation(80% vs 86%, p < 0.05). Logistic regression showed that AHI was an independent factor to predict the decrease of AHI in head rotation (OR 0.985, 95% CI 0.970-0.979, p < 0.05). Among mild to moderate group (AHI < 30/h), severe group (30/h ≤ AHI < 60/h), and extremely severe group (AHI ≥ 60/h), the percentage decrease of AHI in head rotation was 18.5%, 9.5%, and 2.6%, respectively. Surprisingly, the percentage decrease of AHI of 6 responders in mild to moderate group was more than 50%.

**Conclusion:**OSA patients who respond well to head rotation have less severe disease, and patients with mild to moderate OSA are more likely to improve and benefit from this position. Our research provides potential strategies and insights into the individual treatment of OSA patients.

*EADSM* comment: Positional changes of the body during sleep have been much discussed in relation to non-CPAP OSA therapies. Mostly, whole body position have been considered, while the influence of solely head position changes are less studied. This study further enlightens, which patients that might benefit from such changes in terms of head rotation in supine position.

CPAP

Ann Am Thorac Soc. 2023 Feb 3.

 doi: 10.1513/AnnalsATS.202208-738OC. Online ahead of print.

Link: https://www.atsjournals.org/doi/pdf/10.1513/AnnalsATS.202208-738OC

# Dose-Response Relationship between Obstructive Sleep Apnea Therapy Adherence and Healthcare Utilization

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**Rationale:**Clear definition of optimal positive airway pressure therapy usage in patients with obstructive sleep apnea is not possible due to scarce data on the relationship between usage hours and major clinical outcomes.

**Objective:**To investigate the dose-response relationship between positive airway pressure usage and healthcare resource utilization, and determine the minimum device usage required for benefit.

**Methods:**A linked data set combined de-identified payer-sourced administrative medical/pharmacy claims data from >100 US health plans and individual patient positive airway pressure usage data. Eligible adults (age ≥18 years) had a new obstructive sleep apnea diagnosis between June 2014 and April 2018. All received positive airway pressure therapy (AirSense™ 10; ResMed) with claims data for ≥1 year before, and 2 years after, device setup. Healthcare resource utilization was determined based on the number of all-cause hospitalizations and emergency room visits over 3, 12 and 24 months after positive airway pressure initiation.

**Results:**Data from 179,188 patients showed a clear dose-response relationship between daily positive airway pressure usage and healthcare utilization. Minimum device usage required for benefit was 1-3 h/night. There was a statistically significant decrease in hospitalizations and ER visits at all time points (all p<0.0001) with increasing PAP usage. Each additional h/night of usage decreased hospitalizations/emergency room visits by 5-10%/5-7%.

**Conclusions:**These data provide compelling evidence for a dose-response relationship between positive airway pressure usage and healthcare utilization, with benefits seen even when usage is as low as 1-2 h/night.

*EADSM* comment: Study in a huge sample shows health benefits of OSA treatment, even at low adherence, although with a clear dose-dependent relationship. It would be interesting to know more about the same question for MAD-therapy, where the importance of efficacy in relation to adherence could be further studied.

Eur J Pain. 2023 Feb 3.

 doi: 10.1002/ejp.2085. Online ahead of print.

Link: https://onlinelibrary.wiley.com/doi/epdf/10.1002/ejp.2085

# Enhanced pain sensitivity in obese patients with obstructive sleep apnoea syndrome is partially reverted by treatment: An exploratory study

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**Background:**Obesity is frequently associated with obstructive sleep apnoea syndrome (OSA) and chronic pain. OSA as well as continuous positive airway pressure (CPAP) treatment may modulate the pain perception threshold (PT) in patients with obesity.

**Methods:**In this prospective, longitudinal study, all patients admitted for obesity assessment were screened for OSA by nocturnal polygraphy (SOMNOcheck® , IAH ≥10) and performed mechanical (Von Frey electronic device) and electrical (PainMatcher® ) pain tests. Those with severe OSA were retested for PT 1 month after initiation of CPAP therapy. Newly diagnosed patients with severe OSA (hypopnea apnoea index >30) have been offered to start CPAP treatment.

**Results:**Among 85 patients, there were 27 OSA patients, aged between 40 ± 13.2 years with a BMI of 42 ± 7.2 kg/m2 . Severe OSA patients (N = 11) showed a lower PT than non-OSA patients (N = 58) during mechanical (177 ± 120 vs. 328 ± 136 g, p < 0.01) and electrical methods (7.4 ± 6.4 vs. 12.9 ± 6.7 stimulation duration steps; p = 0.03). In the severe OSA group (N = 7), an increased PT was observed 1 month after CPAP treatment during mechanical pain testing (298 ± 69 vs. 259 ± 68 g, p < 0.05), but not during electrical pain testing (11.5 ± 3.0 vs. 12.4 ± 3.8 stimulation duration steps, p = 0.50).

**Conclusion:**In patients with obesity, this exploratory study showed that the presence of an OSA is associated with a decreased PT, whereas implantation of a CPAP device tends to normalize pain perception.

*EADSM* comment: Exciting field to know more about; Could sleep apnea treatment positively influence pain perception?

Ann Am Thorac Soc. 2023 Feb 17.

 doi: 10.1513/AnnalsATS.202208-676OC. Online ahead of print.

Link: https://www.atsjournals.org/doi/epdf/10.1513/AnnalsATS.202208-676OC?role=tab

# Cardiovascular Outcomes in Adults with Coronary Artery Disease and Obstructive Sleep Apnea with vs without Excessive Daytime Sleepiness in the RICCADSA Cohort

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**Rationale:**Recent randomized controlled trials did not show cardiovascular benefits of continuous positive airway pressure (CPAP) in adults with coronary artery disease (CAD) and obstructive sleep apnea (OSA) in intention-to-treat analysis. It has been argued that exclusion of OSA patients with excessive daytime sleepiness (EDS), who may be most likely to benefit from CPAP treatment, may be a reason for the null results.

**Objectives:**We addressed 1) the effect of concomitant EDS on adverse outcomes in patients with CAD and OSA, and, 2), whether the cardiovascular benefit of CPAP adherence differs between individuals with vs. without EDS.

**Methods:**This was a secondary analysis of the RICCADSA trial, conducted in Sweden between 2005 and 2013. Data were analyzed from 155 CAD patients with OSA (apnea-hypopnea index ≥ 15/h) and EDS (Epworth Sleepiness Scale [ESS] score≥10), who were allocated to CPAP, and 244 patients without EDS (ESS<10), who were randomized to CPAP or no-CPAP. Patients who were allocated to no-CPAP or non-adherent (CPAP usage< 4 hours/night) were compared to adherent patients (CPAP usage ≥ 4 hours/night) at 1-year follow-up. Inverse-probability of treatment weighting was applied to mimic randomization of EDS. The primary end-point was the first event of repeat revascularization, myocardial infarction, stroke or cardiovascular mortality.

**Results:**The median follow-up was 52.2 months. The incidence of the primary endpoint did not differ significantly between the EDS vs. no-EDS groups in the entire cohort. Within the adherent group, patients without EDS had a significant decreased risk compared to patients with EDS (adjusted hazard ratio 0.41, 95% confidence interval 0.20-0.85; p = 0.02).

**Conclusions:**Adverse cardiovascular outcomes did not differ by levels of EDS for CAD patients with OSA, who were untreated or non-adherent to treatment. CPAP use, at least 4 hours/night, was associated with reduced adverse outcomes in participants without EDS. Clinical trial registered at Clinicaltrials.gov ([NCT00519597](http://clinicaltrials.gov/show/NCT00519597)).

*EADSM* comment: The influence of daytime sleepiness on the risk of cardiovascular consequences of untreated OSA, has been a lot discussed. This study finds that patients with coronary artery disease, but without EDS, also benefit from CPAP therapy in terms of adverse cardiovascular outcomes.

Orthodontics and surgery

Sleep Breath . 2023 Feb 20.

 doi: 10.1007/s11325-022-02761-5. Online ahead of print.  
Link: [What changes in maxillary morphology from distraction osteogenesis maxillary expansion (DOME) correlate with subjective and objective OSA measures? - PubMed (nih.gov)](https://pubmed.ncbi.nlm.nih.gov/36806968/)

# What changes in maxillary morphology from distraction osteogenesis maxillary expansion (DOME) correlate with subjective and objective OSA measures?

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**Objectives:**To correlate skeletal and airway measures on imaging with polysomnographic and self-reported measures after distraction osteogenesis maxillary expansion (DOME), in the effort to identify clinically relevant sites of expansion to guide treatment for adult patients with obstructive sleep apnea (OSA).

**Materials and methods:**This is a retrospective study reviewing subjects who underwent DOME and had the complete set of the following data: peri-treatment cone-beam computed tomography (CBCT) scans, polysomnography (PSG), Epworth Sleepiness Scale (ESS), and nasal obstruction symptom (NOSE) scores.

**Results:**Of 132 subjects who underwent DOME, 35 met inclusion criteria (71% men, mean age 27.7 ± 6.5 years, mean BMI 26.0 ± 6.4 kg/m2) and were enrolled in the study. There was a significant reduction in the NOSE score from 11.4 ± 5.5 to 3.6 ± 3.1, in the ESS score from 12.0 ± 4.6 to 7.1 ± 4.7, and in the apnea-hypopnea index (AHI) from 17.1 ± 15.8 to 7.01 ± 6.2 (p < 0.0001), after DOME. Nasal floor width at the nasopalatine canal level showed a statistically significant correlation with AHI reduction (p < .0001).

**Conclusions:**DOME is significantly associated with reduction of nasal obstruction, sleepiness, and severity of OSA. The findings suggest that expansion at the anterior third of the bony nasal passage, specifically where the nasopalatine canal is located predicts its clinical efficacy. This site may be a useful target anatomically via imaging.

*EADSM* comment: Retrospective data developing the knowledge about the possibilities to treat selected adult OSA patients with distraction osteogenesis, widening the maxilla. Next study suggests that DISE could be a possible future tool to find the good candidates for maxilla widening procedures.

J Clin Sleep Med. 2021 Jul 1;17(7):1465-1473.

 doi: 10.5664/jcsm.9226.  
Link: [Correlation between the transverse dimension of the maxilla, upper airway obstructive site, and OSA severity | Journal of Clinical Sleep Medicine (aasm.org)](https://jcsm.aasm.org/doi/10.5664/jcsm.9226)

# Correlation between the transverse dimension of the maxilla, upper airway obstructive site, and OSA severity

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**Study objectives:**Acquiring a better comprehension of obstructive sleep apnea physiopathology can contribute to improving patient selection for surgical treatments. We hypothesize that maxillary transverse deficiency restricts the space available for the tongue, leading to upper airway obstruction during sleep. Our primary hypothesis was that maxillary transverse deficiency increases the prevalence of tongue collapse during drug-induced sleep endoscopy (DISE). The secondary hypothesis was that maxillary transverse deficiency will also increase the prevalence of circumferential collapse at the velopharynx. The exploratory hypothesis was that maxillary transverse deficiency is associated with increased obstructive sleep apnea severity. The objectives of this study were to correlate maxillary morphometric measurements with (1) the anatomic level of obstruction during DISE and (2) the apnea-hypopnea index on polysomnography.

**Methods:**We made a cross-sectional analysis of patients with obstructive sleep apnea undergoing DISE in search of positive airway pressure alternative treatment. Maxillary measurements were collected from a computed tomography scan (interpremolar distance, intermolar distance [IMD] and sella-nasion A point angle), findings from DISE, and sleep study variables from polysomnography. Correlation between computed tomography, DISE, and polysomnography data was assessed using Pearson's correlation, and receiver operating characteristic curves were determined for each facial measurement.

**Results:**Sixty-nine patients were included in the study. The group with velopharyngeal circumferential collapse had mean IMD = 26.30 mm (25.5-31.45), and the group with anteroposterior collapse had mean IMD = 29.20 mm (26.8-33.10; P = .040). The group with complete tongue-base obstruction had mean interpremolar distance = 26.40 mm (25.1-28) and IMD = 26.30 mm (25.6-28.4), and the group without obstruction had mean interpremolar distance = 28.7 mm (27.2-30; P = .003) and IMD = 34.06 mm (32.1-37; P < .001). The receiver operating characteristic curve determined an IMD cutoff of 29.8 mm for predicting tongue-base obstruction.

**Conclusions:**The maxillary transverse deficiency, identified by reduction in interpremolar distance and IMD, predicted the occurrence of complete tongue-base obstruction, complete concentric collapse at the velopharynx, and multilevel obstruction during DISE. We did not find an association between the maxillary measurements and obstructive sleep apnea severity. These associations hold some promise in ultimately supplanting insights previously available only through DISE.

*EADSM* comment: Study showing the possible future benefits of using DISE to identify patients who could be treated with methods widening the maxilla.

**REFERENCES**

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