A Novel Use of Polysomnographic Airflow Shape to Predict Treatment Efficacy of Oral Appliance Therapy in Sleep Apnea Patients

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ABSTRACT

Study Objectives: Sleep apnea is a disorder characterized by repetitive collapse of the upper airway causing patients to stop breathing hundreds of times during sleep. Oral appliance (OA) therapy has recently become a common treatment option for obstructive sleep apnea (OSA), but treatment efficacy is highly variable with only 50% of patients achieving a complete therapeutic response. It is suggested that OA treatment efficacy depends on which structure of the upper airway (e.g. tongue, palate, or epiglottis) is collapsing during sleep. The present study hypothesizes that "site" of upper airway collapse is predictive of oral appliance treatment efficacy.

Methods: Two sleep studies were conducted on 86 patients with OSA: one before and another during oral appliance therapy treatment. Standard measurements were made during sleep, which included airflow, sleep apnea severity was quantified as the number of apneas (complete obstruction) and hypopneas (partial obstruction) per hour of sleep. Site of upper airway collapse (i.e. tongue, palate, or epiglottic obstruction) was estimated using "flow shapes" calculated from the airflow data. The association of flow shapes (i.e. site of collapse) with treatment efficacy (percent reduction in apnea-hypopnea index [AHI] with OA treatment) was assessed using Spearman’s correlation.

Results: Lower treatment efficacy on oral appliance therapy was significantly associated with "pinched" expirations (i.e. palate-based obstruction) and the presence of discontinuities in inspiration (i.e. epiglottic-based collapse). While higher treatment efficacy was associated with "flat-top" inspirations (i.e. tongue-based obstruction).

Conclusions: Non-invasive measures of site of collapse were associated with OA treatment efficacy and are therefore a potential means for screening patients that are likely to respond to oral appliance therapy.

OPPORTUNITY

Background: Obstructive sleep apnea is a sleep disorder where the airways collapse, causing repetitive reductions or complete cessations in airflow for extended periods. This leads to awakening from sleep several times per hour, causing daytime sleepiness and disruptions in daily life. A popular therapy for OSA is mandibular advancement via oral appliance therapy, however efficacy is highly variable with only 50% of patients achieving complete response. This variability is contingent on site of collapse in the upper airway, meaning OA therapy is "site-specific".

Hypothesis: It was expected that there would be less treatment efficacy of OA in patients with palate-based and epiglottic-based collapse and more efficacy in patients with tongue-based collapse.

APPROACH

Data collection and analysis:

- Polysomnograms performed on 86 patients without and with oral appliance therapy.
- Airflow shapes calculated as described in Figures 2-5 and correlated with AHI reduction (from pre- to post-treatment) using Pearson’s correlation.
- Two-sided P < 0.05 considered statistically significant.

RESULTS

- All results graphs were synthesized using Spearman’s correlation on a set of n = 86.
- Mean pre-treatment AHI was 37.5±22.6 events/hr.
- Mean reduction in AHI from pre- to post-treatment was 44.±47.4 events/hr.

CONCLUSIONS

- Phenotyping polysomnographic airflow recordings may be an important tool for determining predicted treatment efficacy for OA on specific, individual patients, leading to a better overall response rate in patients who use OA therapy.
- Predicted responders, those with tongue-based collapse as indicated by routine polysomnography, should experience relief from sleep apnea quicker due to personalization and suitability of treatment without first having to go through CPAP treatment, for example.