

Deep Learning Analysis of Snoring and Arousal Patterns in Obstructive Sleep Apnea Patients Undergoing Mandibular Advancement Device Therapy

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Objective

Mandibular advancement devices (MADs) are an established treatment for obstructive sleep apnea (OSA), but treatment response varies among individuals. This study aimed to evaluate changes in sleep-disordered breathing following MAD therapy and to explore the feasibility of convolutional neural network (CNN)-based analysis of polysomnographic snoring and arousal patterns as potential physiological features for future individualized assessment of MAD treatment response.

Methods

A retrospective study was conducted using a de-identified database of OSA patients treated with MADs. The planned study cohort comprises 80 patients, with 20 cases currently available in the database. An interim subset of 15 cases was used for preliminary CNN-based analysis of polysomnographic (PSG) images. Separate CNN models were developed for automated classification of snoring versus non-snoring and arousal versus non-arousal patterns. For the current clinical outcome analysis, six patients with complete paired pre- and post-treatment PSG data were evaluated at the patient level. Changes in apnea-hypopnea index (AHI) were assessed using the Wilcoxon signed-rank test. An exploratory treatment response threshold was defined as a $\geq 50\%$ reduction in AHI.

Results

CNN-based analysis of the interim 15-case dataset demonstrated the technical feasibility of automated recognition of snoring/non-snoring and arousal/non-arousal PSG patterns. Among the six patients with complete paired PSG data included in the current clinical outcome analysis, mean AHI decreased from 37.18 ± 12.79 events/h before MAD therapy to 17.97 ± 14.37 events/h after treatment. AHI decreased in all six patients, with a statistically significant pre-to-post reduction (Wilcoxon signed-

rank test, $p = 0.031$). Four of six patients (66.7%) achieved a $\geq 50\%$ reduction in AHI. The current CNN models focused on physiological pattern recognition rather than direct patient-level classification of MAD treatment response.

Conclusion

MAD therapy was associated with a significant reduction in AHI in the current paired clinical analysis. CNN-based analysis demonstrated the feasibility of automated recognition of snoring and arousal patterns from PSG images. Integration of these PSG-derived physiological features with clinical outcomes in the expanding retrospective cohort may provide a basis for future development of individualized MAD treatment-response prediction models.