



ADDED VALUE OF A MANDIBLE MOVEMENT AUTOMATED ANALYSIS TO A TYPE-3 PORTABLE MONITORING IN THE DIAGNOSIS OF OBSTRUCTIVE SLEEP APNEA*

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INTRODUCTION: In-laboratory polysomnography (PSG) is the "gold standard" for diagnosing Obstructive Sleep Apnea (OSA) but it is time-consuming and costly, with long waiting lists in many sleep laboratories. Therefore, the search for alternative methods to detect respiratory events is growing. The goal of this study was to validate a new diagnostic method based on the automatic analysis of nasal airflow (NAF), blood oxygen saturation (SpO₂), and mandible movement.

METHODS: We compared attended PSG to a portable monitoring device (PM) in 423 consecutive subjects (292 men, 131 women, age: 49±13; BMI: 29.3±7.1 kg/m²) visiting a sleep laboratory due to unrecovery sleep. Recording with PM was made simultaneously with PSG. Out of the signals recorded by the portable monitoring device, we extracted NAF, SpO₂, and mandibular movement (MM).

We applied an automated method [1] to analyze the first two signals extracted from the PM recordings (NAF and SpO₂). Then we added the third signal (MM) and applied the same automated analysis method, augmented with mandible movement automated analysis (MMAA). In order to assess the added value of MMAA in the diagnosis of OSA, apnea-hypopnea indices (AHI) with and without MMAA were computed and compared with the AHI from the PSG.

RESULTS: The relevant final diagnoses were OSA (57%); UARS (6%); insomnia/anxiety/depression (11%); Circadian Disorders (4%); Restless Legs Syndrome (3.5%), etc. Thus, the set of recordings considered here covers a wide range of sleep disorders and not only sleep-related breathing disorders.

The correlation between PSG and PM with MMAA was excellent ($r: 0.97$). Accuracy characteristics of PM with or without MMAA are described in Table 1, showing significant improvement in Sensitivity and Negative Predictive Value with MMAA. A Bland&Altman test corroborated the analysis. The mean difference between AHI from PSG and AHI from PM with MMAA was 5.45+/-6.01 (underestimation by PM with MMAA of ~5/h) with limits of agreement [-6.58 ;17.48] whereas the mean difference between AHI from PSG and AHI from PM without MMAA was 15.7+/-6.2 with limits of agreement [-10.35 ;41.83]. Figure 1 gives the regression and Bland & Altman plots for both PM automated analysis (with and without MMAA) versus PSG.

Table 1: Accuracy characteristics of PM automated analysis

AHI: PSG > 20/h; PM > 15/h.	NAF+SpO ₂	NAF+SpO ₂ +MM	p value
Sensitivity (%)	44	83	<0.01
Specificity (%)	100	96	NS
Positive Predictive Value	100	94	NS
Negative Predictive Value	66	86	<0.01

DISCUSSION: Sensitivity results show that a great number of OSA patients can be missed by automated analysis of NAF and SpO₂. The analysis of those two signals alone has a very low negative predictive value, meaning that a negative test result has a good chance to be contradicted by a PSG test. However, when mandibular movement is considered in the analysis, patients with OSA are much more likely to be diagnosed correctly.

This significant improvement of the results can be explained by the ability of MMAA to recognize arousals through the detection of salient jaw movements. Consequently, the hypopneas characterized by a drop of nasal airflow accompanied by an arousal (with or without sufficient desaturation) are detected and included in the computation of the AHI whereas when mandibular movements are not used (NAF+SpO₂ alone) only the hypopneas with sufficient desaturation get detected and included in the AHI. Therefore, the patients who have a tendency to experience hypopneas that are terminated with an arousal but not accompanied by sufficient desaturation get a much better chance to be assessed accurately with MMAA than without MMAA.

* Preliminary results of an ongoing study. To be presented at the European Respiratory Society (ERS) Annual Congress 2011, Amsterdam, The Netherlands.

[1] Midsagittal Jaw Movements Analysis for the Scoring of Sleep Apneas and Hypopneas, *Senny F, Destiné J, Poirrier R*, IEEE Trans Biomed Eng 2008;55(1):87-95.

CONCLUSIONS: In conclusion, the addition of a mandible movement automated analysis to a type 3 portable monitor improves the accuracy in the detection of respiratory events and gives useful information. It improves Sensitivity and Negative Predictive Value, without a significant drop in Specificity and Positive Predictive Value, suggesting that it is an attractive method for the diagnosis of OSA.

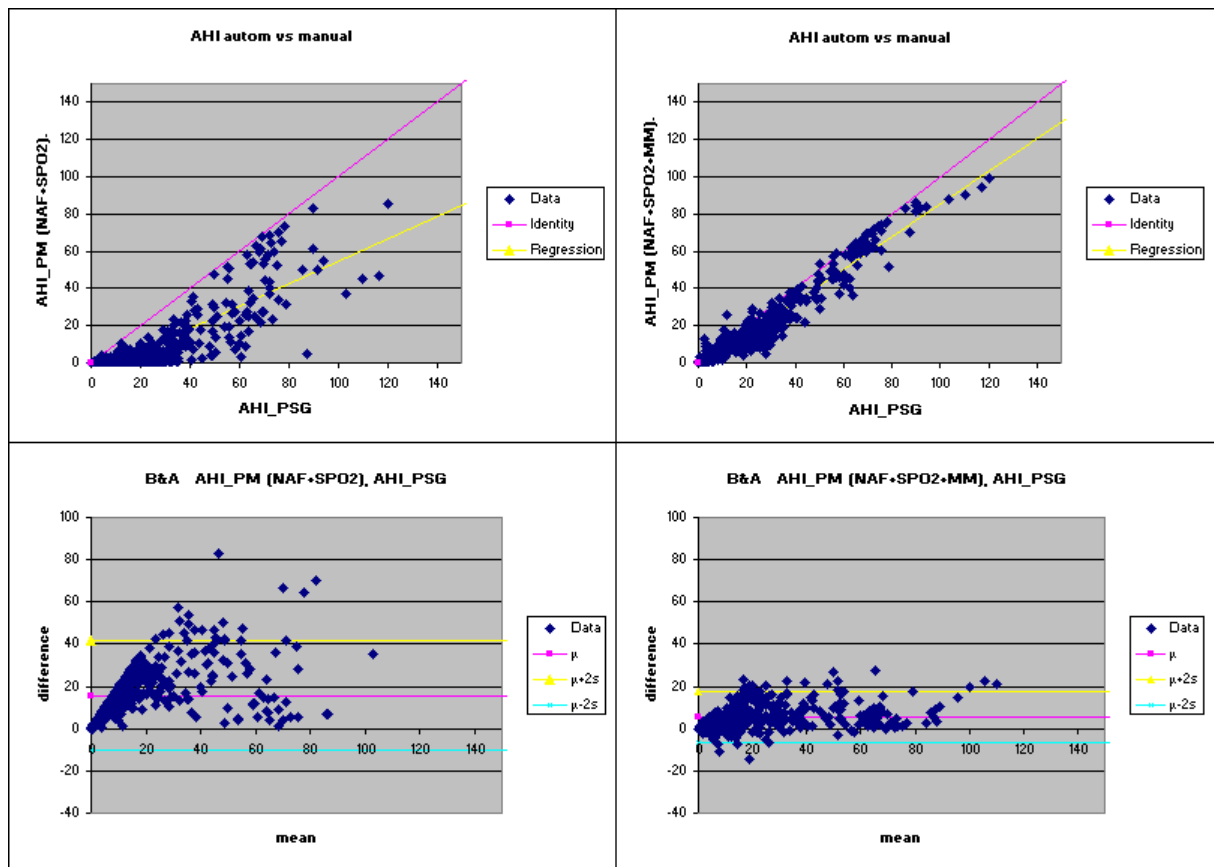


Figure 1:

LEFT - Regression and Bland&Altman plots for the automated analysis of NAF+SPO2.
 RIGHT - Regression and Bland&Altman plots the automated analysis of NAF+SPO2+MMAA.

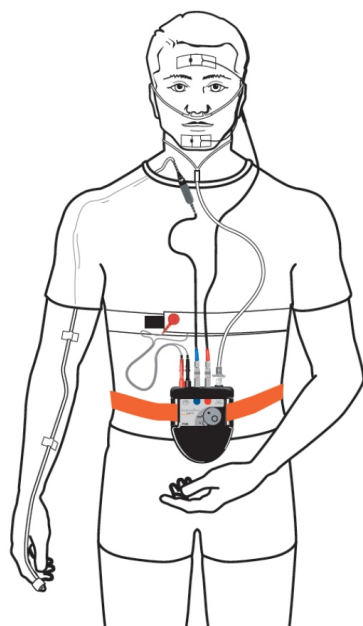


Figure 2:

Somnolter Portable Monitoring Device.

The Somnolter records mandibular movements, nasal flow, thoracic movements, oxygen saturation, pulse rate, plethysmographic pulse wave, and body position. Only nasal flow and oxygen saturation were considered in this study, with or without mandibular movements.