

Evaluation of Micro Sleep Architecture in Patients with Fibromyalgia Utilizing a Novel Computer Assisted Scoring System

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Abstract Number: 0269
Poster Number: 37

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Introduction

- Non restorative sleep (NRS) is based on symptoms of feeling unrefreshed after sleep of seemingly adequate latency, maintenance and duration¹. NRS is a common complaint in fibromyalgia (FM), insomnia and depression.
- PSG findings in patients with FM include the intrusion of alpha waves, which are wake states into non-REM sleep². These alpha-intrusions correlate with overnight pain reporting which may be indicators of NRS.
- Current methods of scoring sleep (Rechtschaffen & Kales³) do not incorporate any index of NRS, and the manual scoring of alpha intrusion is tedious, time consuming, and impractical.
- The Michele scoring system⁴ (MSS) is a computer assisted scoring system that incorporates a new algorithmic value called ORP (odds ratio product), which is a measure of sleep arousability.⁵ ORP is the probability that the power spectrum of EEG patterns analyzed in three second intervals reflects a wake pattern. A higher ORP signifies lighter sleep.
- Average ORP can be determined over specific times or sleep stages and the index ranges from 0 to 2.5 with a value of 1.5 seen as a cut-off between sleep and wake. The value implies the degree of arousability on the sleep/wake axis.⁵
- This study evaluates the relationship between alpha intrusion levels in non-REM sleep and ORP values and their association with subjective reports of fibromyalgia impact.

Methods

- Baseline recordings from a clinical trial of 18 patients diagnosed with fibromyalgia were used in this study. All FM patients reported complaints of poor sleep, pain and fatigue. Patients characteristics are described in table 1.
- Baseline records were independently re-scored by MSS to obtain average ORP during rapid-eye-movement (REM) and non-REM sleep.
- Percent of non-REM epochs with ≥ 3 seconds of alpha-wave intrusion (PNA) was derived manually.
- FM Patients completed the Fibromyalgia Impact Questionnaire which is composed of 10 items relating to FM symptoms experienced in the past week⁶. The FIQ physical impairment sub-scale is based on 11 questions relating to the ability to do large muscle tasks and ranges from 0 to 10 (a higher score indicates a greater impact of FM on a person's daily function).
- Data was analyzed using the SPSS statistical software, version 20.

Results

- PNA ranged from 9-100%. Sixty percent of patients had elevated PNA levels (arbitrarily defined as $\geq 30\%$).
- Average ORP values for all non-REM sleep (stages N1-N3) ranged from 0.36 to 1.39, with an average 0.78 ± 0.27 . This average is similar to the average ORP generally found in non-REM stage N1.⁵ Sample stage 2 sleep EEG of patients with low (0-29%), medium (31-50%) and high level (>50%) of PNAs and ORP values are shown in figure 1.
- Average FIQ physical impairment score ranged from 0.0-7.7 (4.4 ± 2.1). non-REM ORP correlated with PNA values with a spearman correlation coefficient (r) of 0.88 ($p < 0.0001$) (Figure 2, A).
- PNAs correlated with the FIQ physical impairment scores with $r = 0.49$ ($p=0.039$) (Figure 2, B).
- non-REM ORP values correlated with FIQ physical impairment scores with $r = 0.48$ ($p=0.045$) (Figure 2, C).

Table 1. Characteristics of fibromyalgia (FM) patients (n= 18)

Characteristics	Patients
Age (yrs) Mean (SD) Range	50.1 (12.9) 28-72
Sex (n (%)) Female Male	16(88.9) 2(11.1)
Weight Mean (SD) Range	196.7(54.9) 98-188
Duration of FM (yrs) Mean (SD) Range	9.4(7.0) 1-24
Years since FM Diagnosis Mean (SD) Range	4.4(5.2) 0-19
Painful tender points Mean (SD) Range	17.8(0.5) 16-18

Figure 1. Representative stage 2 epoch of 3 FM patients with mild, moderate and severe alpha intrusion

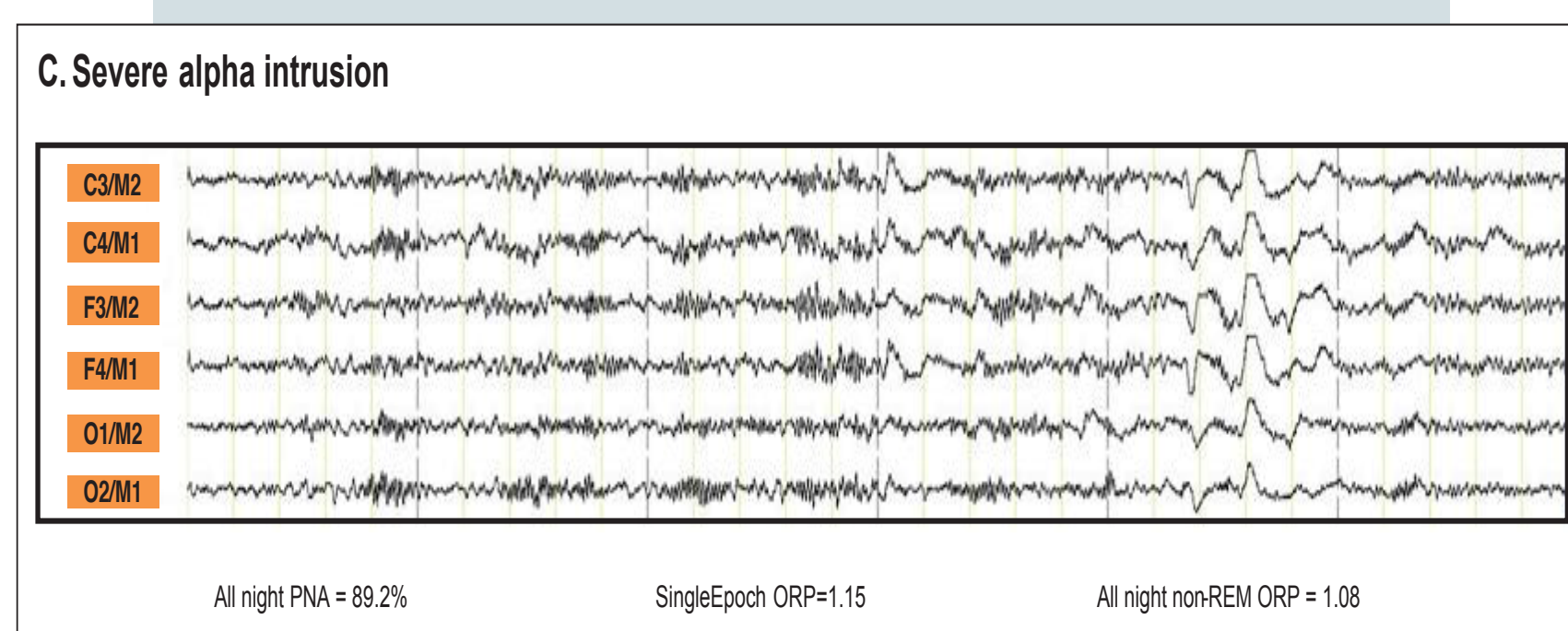
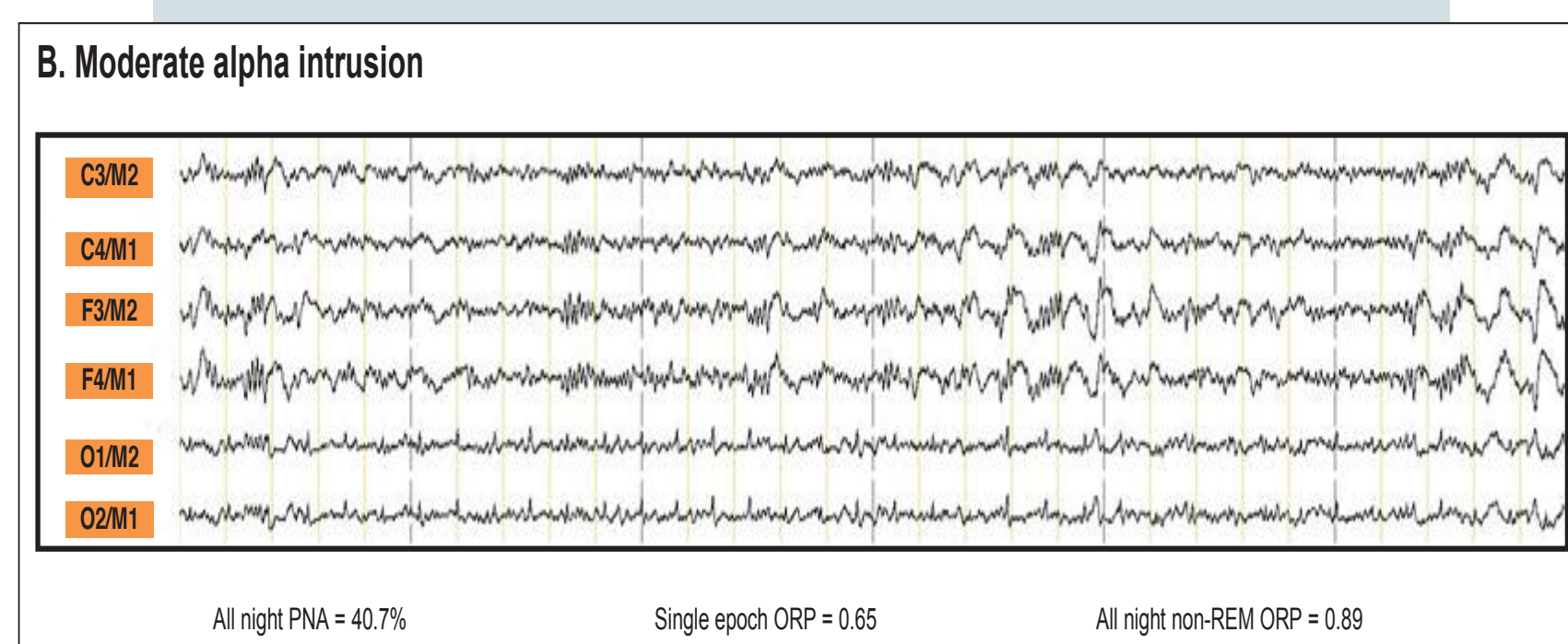
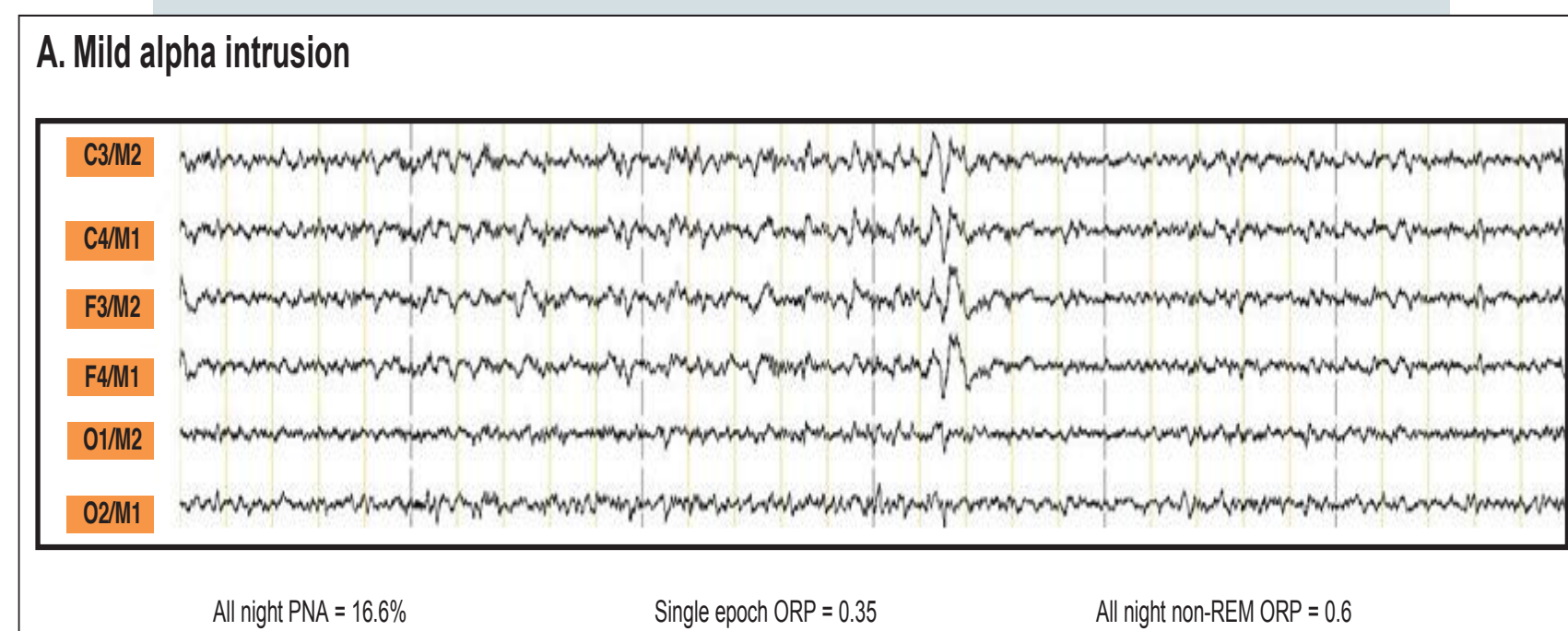
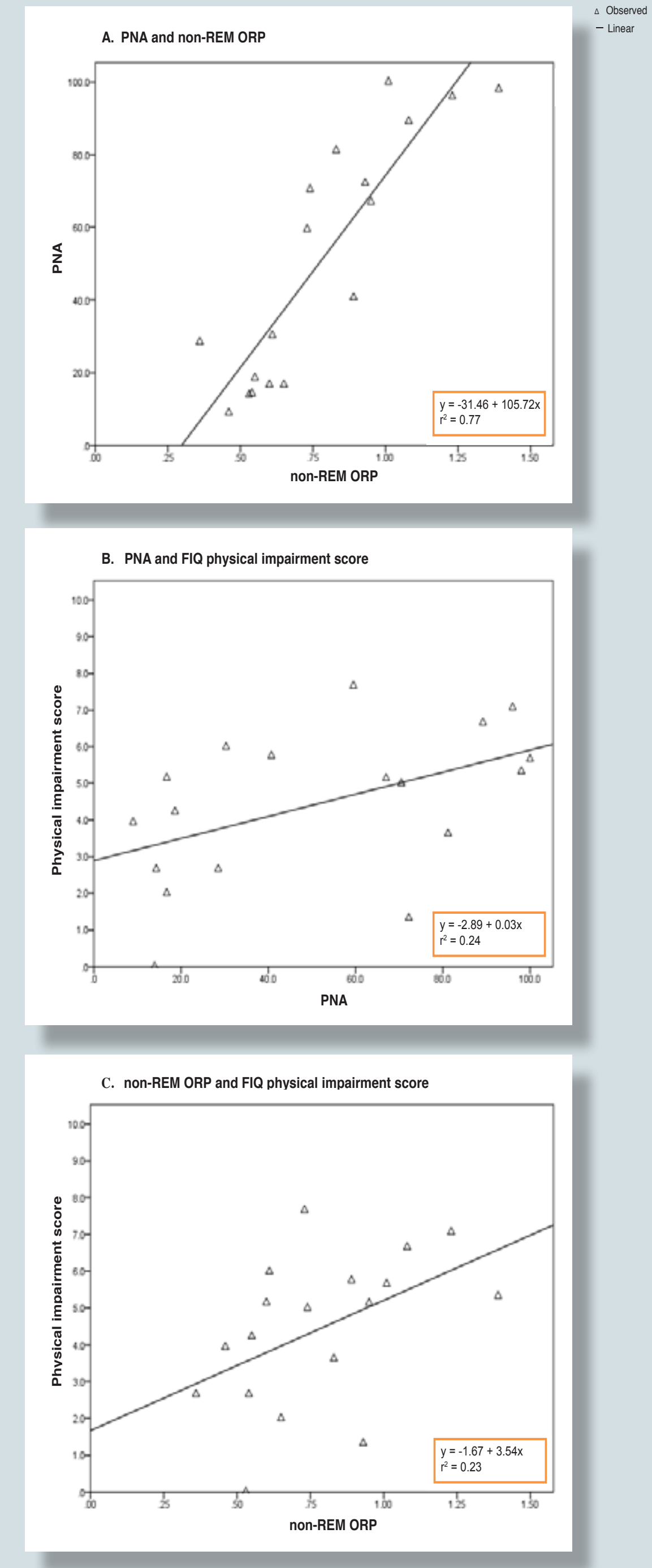


Figure 2. Correlation between non-REM ORP and FIQ physical impairment scores in FM patients



Conclusion

- ORP can be a practical predictive coefficient of NRS, and a useful tool in studying disrupted sleep in a variety of disease states.
- ORP might eliminate the need for manual scoring of alpha in FM studies.
- Further studies are needed to establish the clinical relevance of ORP.

References

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Acknowledgment

The study was supported by Forest Research Institute, Jersey City, NJ.