Symptom Improvement in Fibromyalgia Patients Is Related to Reduced Network Connectivity As Measured by EEG Coherence.

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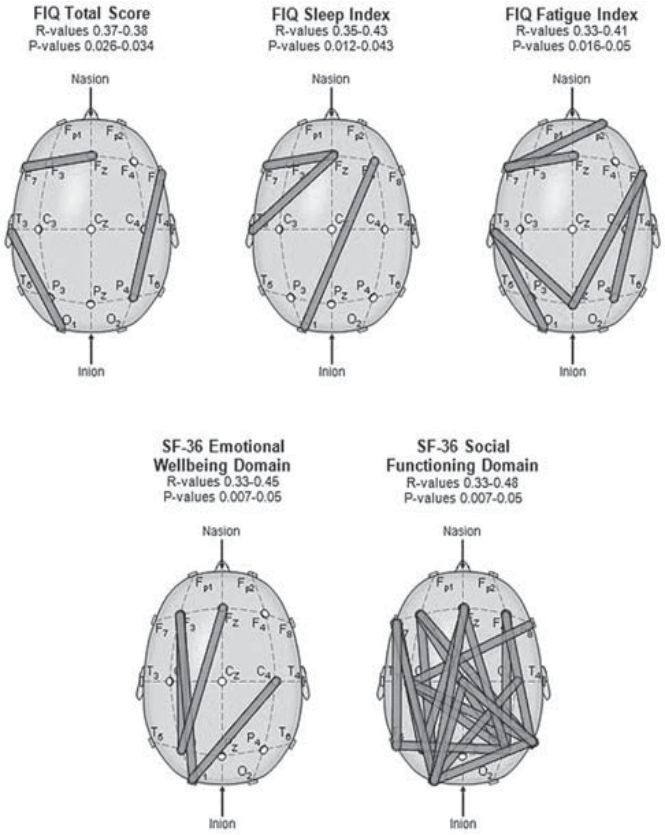
Background/Purpose:
To assess changes in brain functional network connectivity (FC) in fibromyalgia (FM) patients treated with Reduced Impedance Noninvasive Cortical Electrostimulation (RINCE). Previous studies using fMRI have reported increased FC in FM, and pain reduction has been shown to correlate with reduced FC following intervention (Arthritis Rheum. Epub 2012). Herein, we explored the notion that FC, as evaluated by electroencephalography (EEG) coherence, would be reduced by treatment with RINCE and associated with clinical improvements.

Methods:
Changes in EEG coherence in subjects receiving RINCE (N_37) were compared to subjects receiving sham (N_35). Coherence is a correlation of relative amplitude and phase between pairs of EEG signals that provides information about FC across brain regions. Under IRB-approval, eyes-closed resting EEG was collected for each subject at baseline and within one week of RINCE therapy completion. EEG was collected at 19 International 10–20 electrode sites using a linked-ear reference, sampled at 16-bits, 512 samples per second. EEG files were edited to remove non-EEG artifact. To reduce coherence biasing due to cortical volume conduction over short spatial distances, only non-neighboring electrode pairings (N_118) were analyzed. Coherence was calculated using NeuroGuide 2.0 software and low frequency (1–4Hz) signal components were analyzed and compared between groups. FM symptomatology was assessed with the Fibromyalgia Impact Questionnaire (FIQ) and the SF-36.

Results:
Baseline coherence was consistent between groups in 112 of 118 electrode pairs (95%, P_0.05). Following RINCE treatment, a number of significant positive correlations in both inter- and intra-hemispherical electrode pairings were found between change from baseline coherence and improvements in total FIQ and SF-36 domains (see Figure 1). Subjects experiencing reduced coherence in the electrode pairs correlating to FIQ improvement had significantly greater improvements in FIQ total score and pain VAS scale when compared to those with stable or increased coherence (see Table 1).

Table 1. Changes in FIQ total score and pain VAS scale as a function of coherence response

Intragroup Comparisons					
	RINCE Group		**SHAM Group**		
	Reduced Coherence	**Reduced Coherence**	**Reduced Coherence**	**Reduced Coherence**	
Baseline FIQ	58.9	64.1	57.2	59.1	
End-of-Study FIQ	35.4	53.0	49.1	57.2	
P-Value	<0.01	0.023	<0.01	0.80	
Baseline Pain VAS	6.9	6.6	6.7	5.5	
End-of-Study Pain VAS	3.9	4.9	5.6	5.8	
P-Value	<0.01	0.02	0.02	0.87	
Intergroup Comparisons					
	RINCE Group			**SHAM Group**	
	Reduced Coherence	**Increased Coherence**	**P-Value**	**Reduced Coherence**	**Increased Coherence**	**P-Value**
MCFB FIQ	-45%	-19%	<0.001	-14%	-1%	0.07
MCFB Pain VAS	-41%	-20%	0.03	-19%	+7%	0.01
MCFB = mean change from baseline						



Conclusion:

In this study, improvements in FIQ total score and pain VAS scale were greatest in FM subjects showing reductions in brain functional network connectivity based on changes in EEG coherence. This result strengthens previous claims that reduced connectivity may be an objective biomarker of improvement in FM clinical trials. Importantly, it expands the methodology to the use of EEG, which is less costly than fMRI and more generally practical for use in point of care settings.

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