



# LONG-TERM CLINICAL AND CORTICAL EFFECTS OF SYSTOLIC EXTINCTION TRAINING IN FIBROMYALGIA

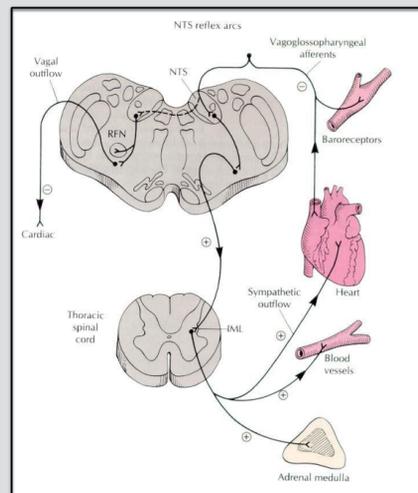
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**Background:** Different studies report diminished baroreflex sensitivity in fibromyalgia (FM) patients that interferes the signal relay to the nucleus tractus solitaries (NTS) termed as NTS reflex arcs is associated with increased peripheral sympathetic stress responses and central sensitization in a hypertensive subgroup of FM.



The present study examined central components of pain processing before and after systolic extinction training (SET) that combines operant behavioral therapy with baroreceptor training. SET aims at new-programming of the NTS reflex arc in FM.

Fig.1 NTS Reflex arcs

**Methods:** 20 FM patients were treated with SET compared to sham therapy (ST) delivered to 32 healthy controls (HC). We evaluated evoked potentials (N50, N150, P260, P390) to electrical stimuli of 3 different intensities during either the systolic or diastolic peak of the cardiac cycle. Clinical pain, pain threshold and pain tolerance were also assessed pre-, post- and at follow-up treatment.

## Design of Systolic Extinction Training - SET

10 two hour Sessions in 5 weeks



Figure 1. Design of SET

**Hour 1:** Structured Extinction Training with Training of Perception and Increase of physical Activity

**Hour 2:** BRS modifying-Stimulation by delivering pain-free and two different pain stimuli adjusted by individual pain tolerance dependent on cardiac cycle

**Analysis:** Before, between and after the test trials, clinical pain and measures of sensory and pain threshold, as well a pain tolerance to electrical stimuli, were assessed. Blood pressure (BP), BRS, and evoked potentials were measured throughout the session.

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**Result1.** Patients receiving SET reported a significant reduction in **Clinical Pain Intensity** post-treatment (all Ps < 0.001).

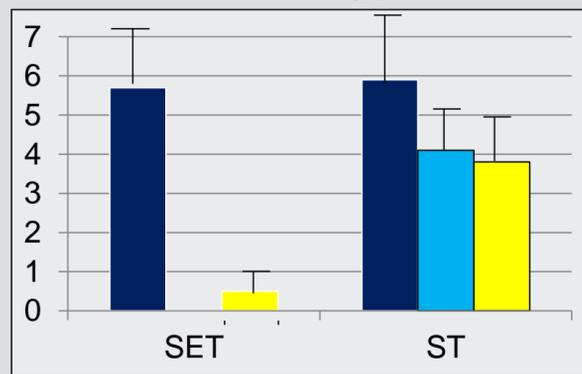


Figure 2. Changes of clinical pain immediately and 12 months after SET and ST

In contrast to the ST group, 82% of the SET participants showed a 12 months lasting pain relieve and in 18% of the patients a pain reduction to 0.68 (VAS 0 - 10, P < 0.001).

**Result2.** Both sensory and **pain threshold** as well as pain **tolerance** increased significantly to **69.53%** and **61.54%** immediately and 6-12 months after SET.

**Result 3.** The pain reduction was associated with a significant increase in **BRS**. The remission of Clinical Pain was associated

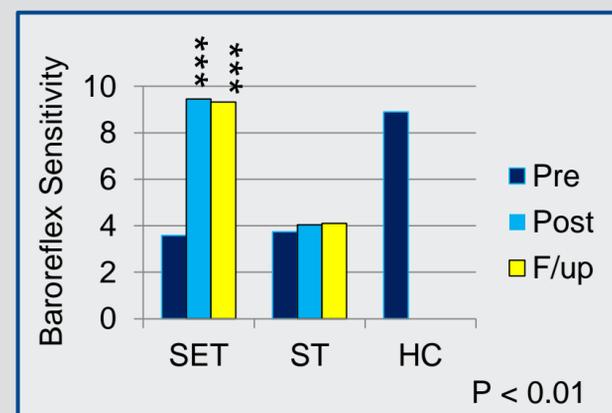


Figure 4. Differences in BRS between FM and ST before, after and 12 months after therapy in comparison to HC

with a significant decrease in **Blood Pressure**, and an increase in **EMG** and **Physical Activity** and **Interference** measured in MPI as well as a low **Catastrophizing** (all P's < 0.01).

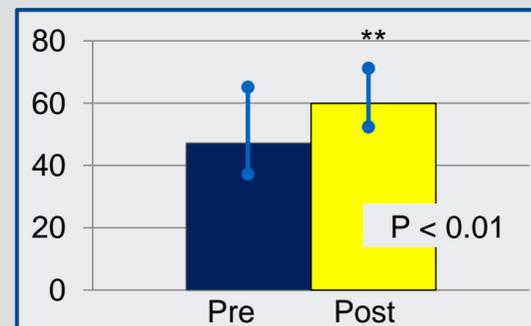


Figure 7. Restoration of sleep architecture after SET

**Result 4.** The number of **deep sleep phases** in the 1<sup>st</sup> half of the night was increased after SET associated with significantly higher **sleep efficacy** and lower number of arousals (all P < 0.01)

**Result 5.** In FM both early and late evoked potentials were influenced by stimulus intensity (all p's < 0.01) before but not after treatment.

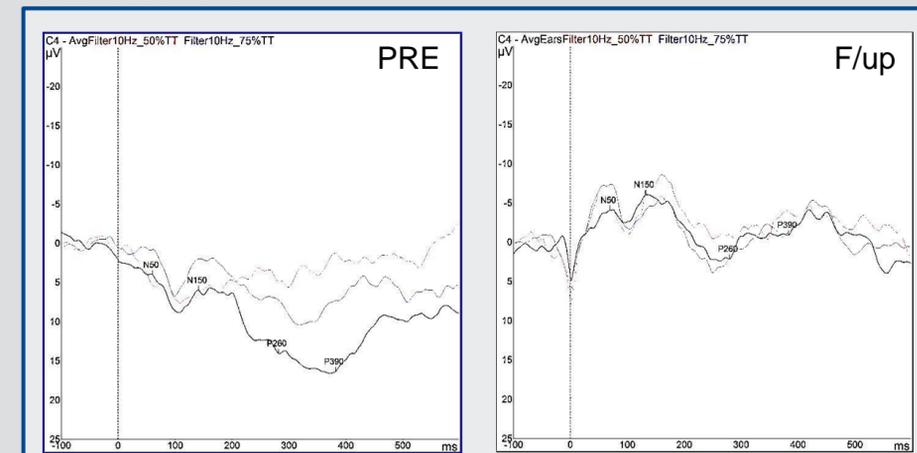


Figure 5. Cortical pain inhibition in C4 before and after SET

**Result 6.** At 6-12 months, the magnitudes of potentials evoked by all stimuli were similar to that evoked in HC at baseline.

**Result 7.** One year after SET, patients showed a higher activated **cognitive (P260)** and reduced **affective (P390)** component of pain (P < 0.001) in the sham protocol but no significant changes of the attention (N50) and sensory (N150) components. The pain inhibition in HC is significantly different than that in FM patients (p < 0.01) who are free of clinical pain.

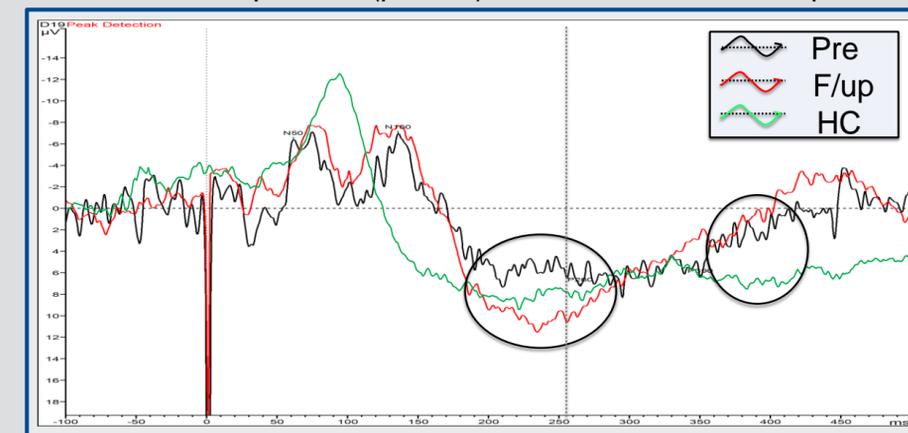


Figure 7. Central pain inhibition after SET in comparison to HC

**Conclusion:** Cardiac gated peripheral afferent stimulation combined with behavioral treatment may induce changes in central pain processing that lead to pain remission in patients with hypertensive stress reactivity. SET activates cognitive and affective brain regions and might create new-program pain inhibitory mechanisms.