

# HOME-BASED EEG NEUROFEEDBACK FOR THE TREATMENT OF CHRONIC MIGRAINE: A MIXED METHODS CASE REPORT

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## Background and Rationale

- Migraine affects one billion people globally, with women three times more likely to be affected<sup>(1,2,3)</sup>.
- Migraine may be partially driven by neuronal hyper-excitability in the cerebral cortex, particularly in the alpha (8-10Hz), beta (13-30Hz) and theta (4-8Hz) frequency bands, impacting sensory processing<sup>(4,5)</sup>.
- Qualitative experiential studies exploring female migraine found adverse effects on work, home life, self-efficacy, and increased psychological distress<sup>(6)</sup>.
- This case study describes a 52 year old woman with chronic episodic migraine who participated in a clinical trial using home-based EEG neurofeedback to target abnormal excitability in the somatosensory cortex.
- Mixed methods were utilised to explore her response to treatment.

## Methods

- The neurofeedback training was performed using the Axon™ system, comprising a purpose-built EEG headset and bespoke tablet-based software.
- The participant completed 47 sessions over 8 weeks. EEG activity was recorded at each session and transmitted via Bluetooth to the app, allowing for real-time modulation of brain activity (Figure 1).

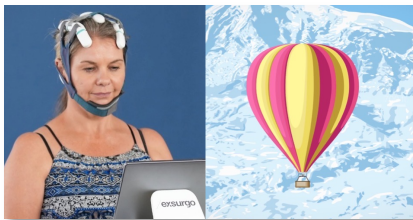


Figure 1: Axon neurofeedback system (L) and one of the 'games' played by the participant (R)

- A selection of 'games' utilised operant conditioning principles and reward-based learning in the form of game progression, to achieve relative alpha upregulation above baseline threshold at each session.
- Pain was measured via online assessment at Week 0 and Week 9, relative EEG power was analysed by averaging relative power values at the beginning of each week, and statistical significance calculated using paired two sample t-test at each time point.
- Qualitative data was collected via online questionnaires at Week 0 and 6, and an interview at Week 9.

## Results

- Pain outcome measures showed substantial reductions in pain at worst (80%), on average (75%) and pain interference (82%) (Figure 2).
- Resting-state relative alpha activity was significantly upregulated, and relative theta and hi-beta downregulated (Figure 3).

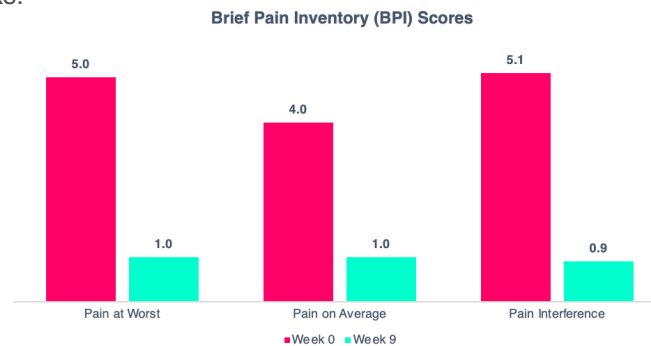


Figure 2: Changes in BPI scores pre-post intervention

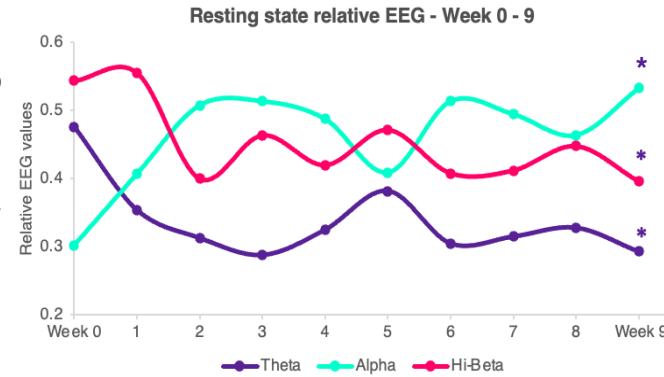


Figure 3: Changes in relative EEG. \* Denotes  $p < 0.05$

## Qualitative findings

- Preliminary thematic analysis identified important concepts that developed during the intervention.
- At Week 0, loss of control was a prominent theme *"I feel like my migraines rule my life and no one can fix the problem.... I would like to feel in control and get my life back"*.
- By Week 6 strategies for training success had developed, changes in her condition were evident and increased confidence was apparent *"the headaches have been almost non-existent...to get through a month without a migraine is amazing ... life changing in many ways and gives me real hope for the future"*.
- At Week 9 she reported increased resilience, a near cessation of migraines and feelings of hope *"things have gone up...each day I'm thinking 'today is a good day and I haven't been ill this month' ...it has definitely given me hope!"*



- Self-efficacy and control can be measured quantitatively, but hope is a more intangible concept, highlighting the importance of qualitative data when researching the complex and subjective nature of chronic pain conditions.

## Discussion and conclusion

- These results suggest that neurofeedback may be a promising treatment for chronic migraine.
- The participant's reduction in migraine frequency and severity signified by changes in pain at worst, on average, pain interference and improvements in affect, show the potential of neurofeedback as a treatment for migraine.
- Changes in resting state EEG indicate the potential efficacy of relative alpha modulation as a mechanism for managing the symptoms of chronic episodic migraine.
- The qualitative findings add substantial value to the quantitative data and provide invaluable insights into the importance of agency, self-efficacy and hope in treating a disease that is poorly understood, with a paucity of effective non-pharmacological treatments.
- Further qualitative and quantitative research is warranted to validate these findings.
- Neurofeedback has the potential to be a valuable adjunctive therapy for individuals living with chronic migraine, offering pain reduction, improved quality of life, and renewed hope.

## References

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