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Passive EEG-Guided Neuromodulation in Chronic Migraine: Findings from a Prospective Feasibility Study with Three-Month Follow-Up Using the Neurogen Brain Balancing Migraine Protocol (NGBBMP)

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Abstract

Introduction: Chronic migraine is a highly disabling neurological condition characterized by recurrent attacks, sensory hypersensitivity, and substantial functional impairment. Many individuals experience incomplete relief from pharmacologic therapies and effort-dependent behavioral interventions. Neurogen Brain Balancing (NGBB) is a fully passive, EEG-guided neuromodulation approach utilizing ultra-low-intensity pulsed transcranial signaling designed to support network-level regulation. This prospective study evaluated feasibility, tolerability, and preliminary clinical response patterns associated with a brief NGBB protocol in treatment-experienced migraineurs. **Methods:** Twenty adults (19 female, 1 male; mean age 40.5 years) with a mean migraine history of approximately 14 years completed five standardized 30-minute NGBB sessions over four weeks. Outcomes included validated migraine disability and impact measures (MIDAS, HIT-6), pain intensity ratings, quality-of-life (QOL) interference scales, global effectiveness ratings, and qualitative reports. Participants were invited to complete a voluntary 90-day follow-up assessment. Analyses emphasized descriptive statistics, pre-/post-comparisons, effect size estimation, and exploratory follow-up distributions. **Results:** Baseline migraine burden was substantial (mean ≈ 13 migraine days/month; mean pain 7.85/10). Following treatment, participants demonstrated marked reductions in disability and headache impact. MIDAS scores declined from 77.7 (Severe Disability) to 16.5 (Moderate Disability), representing an approximate

79% reduction. HIT-6 scores decreased from 67.15 ("Very Severe Impact") to 53.95 ("Some Impact"). Quality-of-life interference improved by approximately 49% across measured domains. Effect sizes were large across principal outcomes (MIDAS d = 4.61; HIT-6 d = 8.32; QOL d = 6.75). At voluntary 90-day follow-up (n = 9 respondents), the majority reported sustained reductions in migraine frequency (89%), intensity (78%), and painfulness (78%). Most respondents clustered within minimal headache burden ranges, and severe pain ratings were absent. No worsening symptom patterns or moderate/severe delayed adverse events were reported. **Conclusions:** In this feasibility study of individuals with long-standing, treatment-experienced migraine, a brief course of passive EEG-guided neuromodulation was associated with rapid, multidimensional reductions in disability and headache impact. Exploratory follow-up findings demonstrated a preliminary durability signal characterized by directional stability across symptom domains and attenuation of peak pain severity. These findings support further investigation in randomized, sham-controlled trials incorporating objective biomarkers and longer-term follow-up.

Keywords

Chronic Migraine, Neuromodulation, EEG-Guided Neuromodulation, Low-Intensity Pulsed Transcranial Electrical Stimulation, Passive Brain Modulation, Neuroplasticity, Migraine Disability

1. Introduction: Neurobiomodulation as a Passive, Next-Generation Neurological Intervention

Neurobiomodulation is an advancing therapeutic domain that employs low-intensity electrical or electromagnetic signals to regulate dysfunctional brain activity and promote the restoration of neural circuitry. Unlike conventional neurofeedback—an effort-based technique requiring the participant to actively modify brainwave patterns through learned strategies—neurobiomodulation is entirely passive. The intervention directly interacts with intrinsic neuroelectric processes, disrupting maladaptive oscillatory patterns and facilitating neuroplastic adaptation without requiring cognitive effort or behavioral engagement. This distinction is especially important in populations with neurological burden, including migraine sufferers, who may be unable to sustain attention-based training due to sensory overload, pain, or fatigue.

1.1. Neurogen Brain Balancing (NGBB) as a Frontier Neurobiomodulation Healing

NGBB operates within a class of passive neuromodulatory systems called neurobiomodulation. It integrates real-time EEG monitoring with ultra-low-intensity pulsed transcranial electrical signaling (LIP-tES) to detect dysregulated brainwave patterns and apply corrective microcurrents tailored to the individual's neuro-

physiology. These microcurrents—typically well below perceptual thresholds—interact with ongoing cortical rhythms to interrupt entrenched maladaptive electrical activity, promote neuroplastic reorganization, and stabilize autonomic function. Early observational evidence suggests that NGBB may shift brain networks toward healthier connectivity by reducing hyperactivity in stress-related circuits, facilitating parasympathetic dominance, and optimizing neural coherence associated with attention, mood, and pain modulation.

The mechanisms proposed for NGBB align with established scientific evidence from related neuromodulation fields. Low-intensity electrical stimulation has been shown to modulate cortical excitability [1], enhance synaptic plasticity via long-term potentiation-like effects [2], and reduce neuroinflammatory signaling [3]. These mechanisms are biologically relevant to migraine, which is increasingly understood as a disorder of cortical hyperexcitability, disrupted thalamocortical rhythms, impaired brainstem pain modulation, and dysregulated autonomic balance. Additionally, neuromodulatory signals can shift dysfunctional oscillatory activity toward normative patterns [4], supporting the rationale for EEG-guided stimulation approaches that target abnormal brainwave dynamics implicated in migraine.

Clinically, neurobiomodulation has demonstrated benefits across diverse neurological and psychiatric disorders, including chronic pain, depression, PTSD, anxiety, post-concussion syndrome, and migraine—conditions that share overlapping pathophysiology involving dysregulated neural networks and autonomic imbalance. Passive modalities like NGBB offer unique advantages: non-pharmacological delivery, minimal side effects, absence of cognitive workload, and accessibility for individuals who cannot tolerate medication or engage in demanding behavioral therapies. Observational reports from neurobiomodulation practitioners consistently describe rapid symptom changes—often within the first few sessions—suggesting that passive modulation may influence network dynamics more quickly than traditional operant-learning-based neurofeedback.

By combining passive EEG-guided stimulation with individualized algorithmic modulation, NGBB provides a compelling, novel approach to disorders characterized by maladaptive neural activity. Given the central role of cortical excitability, oscillatory dysrhythmia, thalamic-pain network dysfunction, and autonomic imbalance in migraine pathophysiology, NGBB's mechanism directly aligns with migraine's neurobiological underpinnings. These converging lines of evidence form the scientific rationale for the present clinical investigation into the effects of NGBB on chronic migraine frequency, intensity, and functional impact.

1.2. Mechanism of Action of NGBB

NGBB utilizes ultra-low-intensity pulsed transcranial electrical signaling (LIP-tES) delivered in conjunction with real-time EEG monitoring to identify and modulate dysfunctional neuroelectric patterns. Rather than requiring active engagement or operant learning—as in neurofeedback—NGBB operates as a fully

passive neurobiomodulatory process. The system continuously monitors cortical activity, detects dysregulated oscillations, and applies corrective microcurrents designed to promote stabilization, restore healthy connectivity, and support neuroplastic reorganization. This passive framework is especially advantageous in neurologically burdened populations, including individuals with migraines who may be sensitive to visual stimuli, are cognitively fatigued, or are unable to sustain attentional tasks.

The mechanisms underlying NGBB are not fully understood but are hypothesized to involve several complementary pathways:

1) Modulation of cortical excitability and oscillatory patterns [1] [5].
2) Enhancement of neuroplasticity and network connectivity [2] [6].
3) Modulation of neuroinflammatory processes [3].
4) Autonomic nervous system regulation [7] [8].
5) Restoration of network homeostasis [4].

Section 4.1 interprets these mechanisms in the context of the clinical findings observed in this study.

1.3. Relevance of NGBB Mechanisms to Migraine Pathophysiology

Migraine is uniquely responsive to neuromodulation because its core disturbances—hyperexcitability, dysrhythmia, central sensitization, autonomic imbalance, and impaired pain inhibition—all map onto domains influenced by low-intensity electrical signaling. NGBB's passive EEG-guided modulation directly intersects with these pathways, offering a biologically plausible mechanism for reducing frequency, intensity, and functional impairment.

The multi-level mechanism of action (oscillatory normalization, neuroplasticity, inflammatory reduction, autonomic regulation) creates a convergence of effects that are particularly well-suited for migraine, where no single-locus model fully accounts for the disorder.

1.4. The Burden of Migraine: Prevalence, Societal Cost, and Treatment Limitations

Migraine is one of the most common and disabling neurological disorders in the world. According to the Global Burden of Disease (GBD) Study, migraine affects over 1.1 billion people globally and is consistently ranked as the second most disabling condition among all diseases and the leading cause of disability in people under age 50 [9] [10]. In the United States alone, migraine affects approximately 39 million adults, with women three times more likely to be affected due to neurohormonal vulnerability [11].

Chronic migraine—defined as 15 or more headache days per month for at least three months—affects roughly 4% of the population, yet accounts for the majority of medical costs, lost productivity, and disability. Individuals with chronic migraine experience significant reductions in physical function, concentration, sleep quality, emotional stability, and capacity to maintain work or social responsibili-

ties. Many reports are feeling trapped in a cycle of pain, medication use, and functional impairment that dramatically reduces overall quality of life.

1.4.1. Economic and Societal Cost

The societal burden of migraine is profound. In the U.S. alone, migraine incurs an estimated $36 billion annually in direct medical spending and indirect costs such as absenteeism, presenteeism, reduced productivity, and disability [12] [13]. Employers lose millions of workdays each year due to migraine-related impairment, with chronic migraine sufferers losing over 5 hours of work productivity per week on average [14]. Patients frequently experience anxiety, social withdrawal, and depression due to the unpredictable nature of attacks, creating a multidimensional burden that affects families, workplaces, and communities.

1.4.2. Limitations of Current Migraine Medications

Despite their widespread use, standard pharmacological treatments—including triptans, CGRP inhibitors, antiepileptics, SSRIs/SNRIs, and beta-blockers—are often inadequate for chronic migraine sufferers. Data from large-scale clinical reviews show that:

1) Up to 40% of migraine patients discontinue preventive medications due to inefficacy or intolerable side effects [15].

2) Preventive medications provide only a 30% - 50% reduction in monthly headache days in many individuals—far from full relief [16].

3) Medication overuse itself is a major clinical problem, with medication overuse headache (MOH) occurring in up to one-third of chronic migraine patients [17].

4) Many medications require weeks to months to take effect, yet produce sedation, cognitive fogginess, depression, weight gain, or cardiovascular risks.

In short, no current medication effectively resolves chronic migraine in most patients, and many experience a continuous cycle of partial relief, rebound headaches, and cumulative side effects.

1.4.3. The Ineffectiveness and High Burden of Traditional Neurofeedback for Treating Migraines

Given the limitations of medication, behavioral and neuromodulatory approaches—particularly neurofeedback—have gained attention. However, traditional neurofeedback presents its own significant challenges:

1) Thirty to forty sessions are commonly required before meaningful change is seen [18].

2) Many clinical protocols require 2 - 3 sessions per week for 3 - 5 months, which is costly and difficult for chronic pain patients to maintain.

3) Results are highly variable and depend on participant effort, attention, and learning ability—precisely the domains that migraines disrupt (cognition, focus, visual tolerance).

4) Studies of neurofeedback for migraine show mixed outcomes, with small effect sizes and high dropout rates [19] [20].

5) Neurofeedback relies heavily on operant conditioning, requiring sustained cognitive engagement, which is often impossible during migraine flares or for individuals with sensory sensitivities.

Thus, while neurofeedback is promising, it remains labor-intensive, slow, and inconsistent, making it inaccessible or ineffective for many migraine sufferers.

1.4.4. The Need for a Passive, Faster-Acting Neuromodulation Approach

Given the enormous global burden of migraine, the limited efficacy of medication, and the impracticality of traditional neurofeedback, there is a strong rationale for investigating passive neuromodulation platforms that require no cognitive effort, are well tolerated, and may deliver more rapid symptom improvement.

NGBB provides such a model by combining EEG-guided detection of dysregulated cortical patterns with ultra-low-intensity pulsed transcranial electrical signaling designed to normalize brain activity. Its passive approach may be especially beneficial for migraine patients who cannot tolerate bright screens, sustained attention, or cognitive tasks. This proposed study aims to evaluate the reduction of migraines by only five (5) passive thirty-minute sessions administered in-person over three (3) weeks.

1.5. Observational and Case-Based Evidence Relevant to Neurogen Brain Balancing

Preliminary observational reports and practitioner-documented cases have suggested that Neurogen Brain Balancing (NGBB) may influence neurological domains relevant to migraine pathophysiology, including pain modulation, sensory processing, emotional regulation, sleep architecture, and autonomic balance. Although these reports are anecdotal and uncontrolled, they provide context for the present pilot study and inform its rationale.

1.5.1. Neurological and Neurophysiological Observations in High-Exposure Populations

Early reports include individuals with extensive cumulative neurological stressors, including traumatic brain injury (TBI), blast exposure, chronic pain, post-traumatic stress symptoms, sleep disturbance, and recurrent migraines. In some cases, participants reported rapid reductions in migraine frequency and severity following NGBB sessions, alongside improvements in sleep, mood stability, and pain perception.

In one extensively documented case, quantitative electroencephalographic (qEEG) recordings obtained before and after a series of NGBB sessions demonstrated a shift from patterns characterized by cortical hyperactivation toward more normalized activity distributions. These neurophysiological changes temporally coincided with reported reductions in migraines, sleep disturbance, and emotional dysregulation. While such findings cannot establish causality, they suggest a potential association between neuromodulatory intervention and large-scale network regulation.

1.5.2. Emotional Regulation, Sleep, and Stress-Related Outcomes

Additional reports from individuals with chronic stress exposure, post-traumatic symptoms, and affective dysregulation described improvements in emotional reactivity, sleep duration, and perceived stress tolerance following NGBB treatment. Improvements in sleep quality and emotional stability are particularly relevant given their established role as predictors and modulators of migraine frequency and severity.

Across multiple cases, individuals noted reductions in anxiety, irritability, and stress-related symptom exacerbation, suggesting possible effects on limbic-autonomic coupling and central arousal regulation. These domains are increasingly recognized as integral components of migraine pathophysiology rather than secondary features.

1.5.3. Medication Reduction and Functional Improvement

Several reports described reduced reliance on psychotropic or analgesic medications following NGBB treatment, accompanied by perceived functional improvements in daily activities, interpersonal relationships, and occupational performance. While self-reported and uncontrolled, these observations align with emerging interest in non-pharmacologic neuromodulatory approaches for chronic migraine and comorbid conditions.

1.6. Practitioner-Documented Case Reports Relevant to Migraine Mechanisms

Practitioner-collected case reports further support the biological plausibility of NGBB for migraine-related symptom domains. These cases span diverse clinical populations but converge on shared mechanisms relevant to migraine.

Reports include individuals with traumatic brain injury and severe photophobia who demonstrated substantial reductions in light sensitivity and post-concussive headaches following NGBB sessions. Given that photophobia, cortical hyperexcitability, and sensory amplification are hallmark features of migraine, these findings are mechanistically relevant.

Other cases involving insomnia, anxiety, fatigue, and autonomic dysregulation reported improvements in sleep quality, emotional regulation, and energy levels. Because sleep disruption and sympathetic overactivation are among the strongest predictors of migraine chronification, these outcomes support indirect pathways through which neuromodulation may influence migraine burden.

Pediatric and adult cases with comorbid attention dysregulation, chronic pain, inflammatory conditions, and central sensitization also demonstrated reductions in headache frequency, pain intensity, and cognitive strain following treatment. These findings are consistent with a central regulatory effect on pain processing and network-level excitability.

A published case report presented at the 2023 Neuro-Optometric Rehabilitation Association conference documented reductions in photophobia, post-concussive symptoms, and headache impact using validated instruments (UPSIS-17, RPCSQ,

HIT-6). Because migraine shares overlapping features with post-concussive and sensory hypersensitivity syndromes, such data provide further mechanistic support for investigating NGBB in migraine populations [21].

Summary Integration

Taken together, these observational and case-based reports suggest that NGBB may influence physiological systems central to migraine expression, including sensory hypersensitivity, cortical dysregulation, central sensitization, sleep disturbance, emotional reactivity, and autonomic imbalance. While anecdotal and not suitable for efficacy claims, their convergence across populations provided an evidence-informed rationale for conducting the present prospective pilot study in individuals with chronic migraine.

1.7. Clinical Rationale for the Neurogen Migraine Protocol (NGBBMP)

A recent paper by Kasian and Turetzky (2025) presents one of the most comprehensive evaluations of NGBB to date [21]. It includes both individual case studies and a large pilot study of 132 U.S. veterans. The veteran study surveyed participants from May 2023 through January 2025 and used standardized 0 - 10 subjective distress ratings before and after four NGBB sessions. The study found that after only four sessions, 79% reported consistent improvements across the ten most commonly reported symptoms—headaches, sleep disturbance, depression, PTSD, anxiety, anger, pain, focus, memory, and brain fog—demonstrating broad neurophysiological and functional benefit across a diverse clinical population. Because veterans were recruited naturalistically without pre-selection criteria, the findings may better reflect real-world outcomes than results from highly controlled laboratory studies.

Kasian and Turetzky (2025) provide further mechanistic support in their study. One Navy veteran with severe post-concussive light sensitivity experienced a 59% reduction in photophobia, a 73% reduction in post-concussive symptoms, and a 37% reduction in headache impact after Neurogen treatment, measured through validated instruments including UPSIS-17, RPCSQ, and HIT-6 [21]. These findings demonstrate that NGBB not only reduces subjective symptom burden, but also produces quantifiable changes on standardized headache and neurological impact scales. These findings support the proposed mechanism of action: modulation of dysfunctional brainwave patterns via low-intensity pulse transcranial electrical signaling informed by real-time EEG feedback, consistent with observed qEEG shifts from hyperactivated cortical regions toward balanced, normative activity following repeated treatments.

Across the 131-veteran cohort, most participants reported clinically meaningful improvements after only four sessions, consistent with reports of no long-term adverse effects across more than 30,000 recorded sessions between 2019 and 2025 [21]. Symptom improvements were broad yet coherent, often including better sleep, reduced anxiety, improved emotional regulation, decreased pain, and clearer cog-

nition. These benefits are consistent with the established neurobiomodulation framework described in the article, in which low-intensity electrical signaling disrupts maladaptive neural patterns, promotes neuroplasticity, and rebalances sympathetic-parasympathetic tone.

Collectively, the findings from this peer-reviewed veteran study provide strong justification for applying NGBB to conditions such as chronic migraine. The improvements in headache severity, headache-related disability, sleep quality, anxiety, and overall neurological function directly parallel the symptom constellation experienced by migraine sufferers. Moreover, the 37% reduction in HIT-6 scores observed in the mTBI case report offers direct evidence that Neurogen influences validated headache-specific metrics. Given that migraine involves dysregulated cortical excitability, sensory hypersensitivity, impaired sleep, and autonomic imbalance, the observed normalization of aberrant EEG patterns strengthens the theoretical rationale for initiating the current Neurogen Migraine Study.

In summary, the veteran study demonstrates that Neurogen Brain Balancing is safe, well-tolerated, and capable of producing meaningful reductions in neurological symptoms after only a small number of sessions [21]. These data, combined with objective qEEG changes and validated improvements in headache-impact scales, provide a strong empirical and mechanistic foundation for evaluating Neurogen's effectiveness specifically for migraine treatments.

The healing technology consists of a computer and a dozen electrodes that are applied to the scalp or sites on the body using a water-soluble, non-toxic paste. They are applied by a growing independent network of Certified Neurogen Practitioners across the U.S. An estimated 30,000 sessions lasting approximately 30 minutes have been logged since the introduction of the technology in 2020. No adverse effects have been noted, aside from a rarely reported headache that fully resolves after a night's sleep, or mild irritation at the site of electrode application where the skin has been abraded. The lack of any notable adverse effects is understandable, given that this NGBB is noninvasive, passive, non-pharmacologic, and delivers a signal that is extremely subtle.

1.8. Rationale for 90-Day Follow-Up Assessment

While immediate post-intervention outcomes are important for evaluating short-term clinical response, assessment of treatment durability is particularly relevant in chronic migraine populations. Migraine is characterized by episodic fluctuation, variable symptom recurrence, and regression toward baseline following many therapeutic interventions. Consequently, follow-up measurements are essential for distinguishing transient symptomatic effects from potentially sustained changes in symptom burden.

Neuromodulation approaches are hypothesized to influence migraine through mechanisms involving cortical excitability, thalamocortical regulation, autonomic balance, and neuroplastic adaptation. Unlike purely pharmacologic or symptomatic treatments, network-level modulation may produce effects that extend beyond the active stimulation period. However, durability of response remains a critical empir-

ical question, particularly for passive neuromodulation paradigms.

To explore the persistence of observed changes following completion of the Neurogen Brain Balancing Migraine Protocol (NGBBMP), participants were invited to complete a voluntary 90-day follow-up assessment. This exploratory follow-up was designed to characterize symptom trajectories, headache burden, pain severity, treatment satisfaction, and tolerability beyond the immediate post-protocol window.

2. Methods

2.1. Study Design

This prospective, single-arm feasibility study was designed in alignment with the CONSORT extension for pilot and feasibility trials. The CONSORT (Consolidated Standards of Reporting Trials) framework provides guidance for transparent reporting, methodological rigor, and reproducibility in early-phase studies, especially when evaluating novel interventions without a comparison group. Applying CONSORT ensures clarity regarding feasibility objectives, recruitment flow, adherence, and preliminary signal detection—elements critical in neuromodulation research, where early-phase trials inform larger controlled studies.

The study evaluated the short-term effects of the Neurogen Brain Balancing Migraine Protocol (NGBBMP), consisting of five standardized 30-minute neuromodulation sessions delivered over four weeks by Certified Neurogen Practitioners. Participants completed validated assessments within four weeks prior to treatment initiation, and many completed a voluntary follow-up protocol four weeks following the sessions. The primary purpose was to assess feasibility, participant adherence, and initial clinical response patterns, rather than to establish causal inference.

Materials

The study included four supporting appendices to clearly document how participants were recruited, screened, and assessed. **Appendix A** included the national email invitation and graphic that practitioners shared to inform potential participants about the study. **Appendix B** contained the brief interest form that allowed the research team to identify individuals who might qualify. **Appendix C** provided the full intake questionnaire used to gather baseline migraine history, symptoms, triggers, treatment background, and validated MIDAS and HIT-6 items. **Appendix D** included the follow-up questionnaire administered after participants completed all sessions, mirroring baseline measures and adding items on perceived improvement and overall treatment experience. Together, these appendices outline the complete participant pathway—from first contact to final assessment—and support the transparency and reproducibility of the study methods.

2.2. Recruitment Procedures

Participants were recruited nationally using a multi-stage dissemination strategy. An email announcement describing the study's purpose, schedule, and participa-

tion requirements was sent to the complete U.S. database of Certified Neurogen Practitioners. Practitioners were encouraged to forward the announcement to their own patient lists and community contacts. Word-of-mouth referral further supplemented recruitment.

Individuals expressing interest completed an online Qualifying Questionnaire that screened for eligibility: age 18 - 75, a self-reported clinical diagnosis of migraine, ability to complete five sessions within 30 days, and capacity to complete electronic questionnaires. Participants were excluded for recognized contraindications to noninvasive neuromodulation, including implanted electronic medical devices, seizure disorders or elevated seizure risk, pregnancy, and compromised skin integrity at electrode sites. Additional exclusion criteria included major neurologic conditions other than migraine, prior brain surgery or significant head injury, unstable medical or psychiatric illness, and factors that could interfere with protocol adherence or data validity. Eligible individuals were sent the baseline assessment packet, which had to be completed within four weeks prior to the first NGBBMP session. Follow-up assessments were collected four weeks after the final session.

All five NGBBMP sessions were provided at no cost. No additional incentives were provided, and participants could withdraw freely at any time.

2.3. Participants

Eligibility criteria required that participants be adults aged 18 - 75 with a self-reported clinical diagnosis of migraine and the ability to complete the full five-session protocol within a 30-day window. Additional criteria included reliable access to a computer or mobile device, willingness to complete all required assessments, and availability to attend all scheduled sessions with a Certified Neurogen Practitioner.

Participants were screened via the Qualifying Questionnaire, which assessed migraine history, general health, schedule feasibility, and neuromodulation safety criteria. To preserve ecological validity, no exclusions were made for comorbidities, concurrent migraine medication use, or prior therapeutic history.

Participants were enrolled after providing informed consent and completing all baseline assessments. Only participants who completed all five sessions and both assessment timepoints were included in the analyses.

2.4. Intervention: Neurogen Brain Balancing Migraine Protocol (NGBBMP)

2.4.1. Protocol Overview

The Neurogen Brain Balancing Migraine Protocol (NGBBMP) is a standardized neuromodulation procedure developed to evaluate feasibility, procedural consistency, and tolerability of patterned, low-intensity stimulation targeting neural networks implicated in migraine pathophysiology. The protocol employs calibrated stimulation intended to engage mechanisms relevant to thalamocortical rhythm stability, cortical excitability, autonomic regulation, and neuroplastic processes,

without making claims regarding therapeutic efficacy. All sessions followed an identical procedural framework. Individualized calibration was performed prior to stimulation to ensure consistency of protocol delivery, after which a fixed stimulation sequence was applied. No protocol modifications or deviations were permitted during the study.

2.4.2. Practitioner Delivery

Sessions were administered in person by one of seven Certified Neurogen Practitioners—based in California (two), Indiana, Oregon, South Carolina, Nebraska, and Amsterdam—trained in standardized delivery of the NGBBMP using the standardized Neurogen hardware, electrodes, and software. Each treatment session lasted approximately 30 minutes. Participants were instructed to maintain their usual medications, supplements, and daily routines throughout the study period in order to minimize confounding variables and support assessment of protocol feasibility. No adverse events or protocol-related safety concerns were reported.

2.4.3. Pulse Characteristics

Signaling was delivered using ultra-low-power electromagnetic signals with a peak output of approximately 2.5 picowatts, corresponding to less than one-ten-thousandth the power of a standard AA battery. Parameters were selected to remain well below established thresholds associated with tissue heating or direct neural excitation, consistent with a noninvasive neuromodulation feasibility design.

2.4.4. Treatment Schedule and Session Structure

Each participant completed five protocol sessions, all utilizing identical anatomical electrode placements. Across sessions, five distinct proprietary stimulation schedules were employed, with one schedule applied per session. Each stimulation schedule utilized a unique waveform configuration designed to differentially engage neural regulatory processes. The schedules included a gentle network-balancing sequence, a calming sequence, two progressively stimulating sequences, and a relaxation-oriented sequence. The order of schedule administration followed a predefined protocol and was identical for all participants to ensure procedural consistency.

2.4.5. Electrode Placement Protocol

Electrode placement followed a proprietary site-pairing sequence derived from the International 10 - 20 EEG system. For the migraine intervention, stimulation sites included the T3/T4 and T4/P4 electrode pairings. These sites correspond to cortical regions implicated in sensory integration, pain processing, and large-scale network regulation. Specific waveform parameters and the full site-pairing logic were proprietary and therefore not disclosed within this feasibility protocol. Information required for study replication may be obtained by contacting the study sponsor.

2.5. Measures

All assessments were administered electronically using a secure, HIPAA-compli-

ant platform. Instruments were selected based on their widespread use in migraine research, strong psychometric properties, and relevance to functional and neurological outcomes.

2.5.1. Migraine Duration and Chronicity

Participants reported total years with migraine. Chronicity is important in interpreting treatment response, as long-standing migraine is associated with central sensitization and altered pain network dynamics.

2.5.2. Monthly Migraine Frequency, Duration, and Pain Intensity

Participants reported monthly migraine days and typical attack duration using standardized categories commonly used in headache medicine. Pain intensity was assessed using the 0 - 10 Numerical Rating Scale (NRS), a validated and widely used metric for pain severity, with strong evidence for reliability, sensitivity to change, and clinical interpretability [22].

2.5.3. Assessment of Migraine Triggers

Participants selected from a checklist of established migraine triggers (stress, bright lights, hormonal changes, weather changes, sleep disturbance). These items represent known precipitating factors affecting cortical excitability, autonomic regulation, and sensory processing in migraines.

2.5.4. Symptom Inventory

Participants endorsed common migraine-associated symptoms, including photophobia, phonophobia, nausea, neck pain, dizziness, and aura. This descriptive inventory aligns with the ICHD diagnostic criteria and provides insight into multisystem burden.

2.5.5. Medication and Modality History

Participants reported current prescription migraine medications and prior use of complementary treatments (acupuncture, massage, behavioral therapy, Botox). These data ensure that feasibility and patient experience are evaluated within a real-world, treatment-experienced population.

2.5.6. Migraine Disability Assessment (MIDAS)

The MIDAS instrument quantifies migraine-related disability across work, home, and social domains by measuring days of missed or reduced productivity. It is validated internationally and exhibits strong reliability and sensitivity [23]. MIDAS was selected for its direct relevance to functional outcomes and widespread acceptance in migraine trials.

2.5.7. Headache Impact Test (HIT-6)

The HIT-6 assesses headache-related impact across pain severity, daily functioning, fatigue, emotional well-being, and concentration. It is a validated and frequently used outcome measure in both episodic and chronic migraine research [24]. Its multidimensional structure aligns well with the expected system-level ef-

fects of neuromodulation.

2.5.8. Quality-of-Life Ratings

Participants rated migraine interference across sleep, work/school, relationships, recreation, and mood using a 1 - 5 Likert scale. These ratings capture broader psychosocial functioning beyond pain metrics and are consistent with integrative models of migraine as a network disorder affecting whole-person well-being.

2.5.9. Treatment Goal Importance and Goal Achievement

Participants rated six predefined treatment goals for personal importance at baseline and later rated the degree to which each was achieved. This patient-centered outcomes strategy is aligned with contemporary neurological and rehabilitation frameworks, emphasizing meaningful functional change.

2.5.10. Global Effectiveness Rating

Participants provided a single 0 - 10 global rating of perceived treatment effectiveness. Global impression scales are commonly used in early-phase feasibility research to complement multidomain quantitative measures.

2.5.11. Statistical and Effect Size Procedures

Consistent with CONSORT recommendations for feasibility studies, analyses emphasized descriptive statistics, pre-/post-comparisons, and estimation of effect sizes rather than formal hypothesis testing. Cohen's d was calculated to characterize the magnitude of change. Percent change was reported for interpretive clarity. All participants completed all assessments; thus, no imputation procedures were required.

2.5.12. 90-Day Follow-Up Procedures

Participants who completed the Neurogen Brain Balancing Migraine Protocol (NGBBMP) were invited to complete a voluntary follow-up questionnaire approximately 90 days following their final neuromodulation session. The follow-up assessment was administered electronically using the same secure survey platform employed for baseline and post-protocol data collection.

The follow-up instrument was designed to capture patient-reported outcomes reflecting migraine status relative to baseline. Domains included perceived changes in migraine frequency, migraine intensity, migraine painfulness, migraine/headache days within the preceding three weeks, average pain severity ratings, treatment satisfaction, and side-effect reporting.

Migraine frequency, intensity, and painfulness were assessed using categorical comparative responses ("less", "about the same", or "more") relative to pre-study baseline. Headache burden was assessed by reporting migraine/headache days experienced within the final three weeks preceding survey completion. Pain severity was evaluated using the validated 0 - 10 Numerical Rating Scale (NRS).

Treatment satisfaction was assessed using ordinal response categories ("very satisfied", "satisfied", "neutral", "dissatisfied"). Side-effect reporting captured the presence and perceived severity of any delayed or persistent effects.

Participation in the follow-up assessment was voluntary. No incentives were

provided, and non-response did not affect participation status. Analyses of follow-up outcomes were therefore descriptive and exploratory in nature, consistent with CONSORT recommendations for feasibility studies.

3. Results

The Neurogen Brain Balancing Migraine Protocol (NGBBMP) produced consistent, multidimensional improvements across validated migraine disability measures, symptom severity indices, quality-of-life (QOL) metrics, and participant-reported outcomes. The intervention consisted of five 30-minute neuromodulation sessions administered over a four-week period (September 15-October 20, 2025) by Certified Neurogen Practitioners (n = 3). Twenty participants (19 female, 1 male), aged 19 - 75 years (M = 40.47), all with a clinical diagnosis of migraine, enrolled in and completed the protocol. Participants were geographically diverse, representing seven U.S. states and two individuals from Netherlands, and demonstrated extensive migraine chronicity: 75% reported ≥10 years of migraine suffering $M \approx 14$ years).

3.1. Participant Duration of Migraines at Study Onset

Migraine duration distributions confirmed an entrenched clinical population unlikely to remit spontaneously. Fifteen participants reported migraine histories of 10 years or longer, including long-standing illness durations of 21, 27, 30, and 55 years. Three participants reported migraines for 6 - 10 years, and two reported 1 - 5 years. This level of chronicity underscores the clinical significance of any subsequent improvements observed during the protocol.

3.2. Baseline Monthly Suffering and Pain Ratings

Baseline headache diaries (Table 1) indicated a substantial pre-intervention burden. Four participants experienced ≥20 migraine days per month, one reported 15 - 19 days, seven reported 10 - 14 days, and eight reported 5 - 9 days per month. Episode duration was similarly prolonged: Five participants reported attacks lasting >2 days, three reported 1 - 2-day episodes, five reported 12 - 24-hour episodes, six reported attacks lasting 4 - 12 hours, and only one participant reported episodes lasting <4 hours.

Table 1. Baseline migraine experience.

Migraine Suffering BEFORE Study			
Days/Month		Duration/Episode	
20+ Days	4	2+ Days	5
15 - 19 Days	1	1 - 2 Days	3
10 - 14 Days	7	12 - 24 Hrs	5
5 - 9 Days	8	4 - 12 Hrs	6
		<4 Hrs Each	1

Baseline pain intensity averaged 7.85/10, with 13 of 20 participants (65%) endorsing pain in the severe range (8 - 10), referencing pain scale in Figure 1. Taken together, these data characterize a persistently symptomatic cohort with marked pre-intervention impairment in daily functioning.

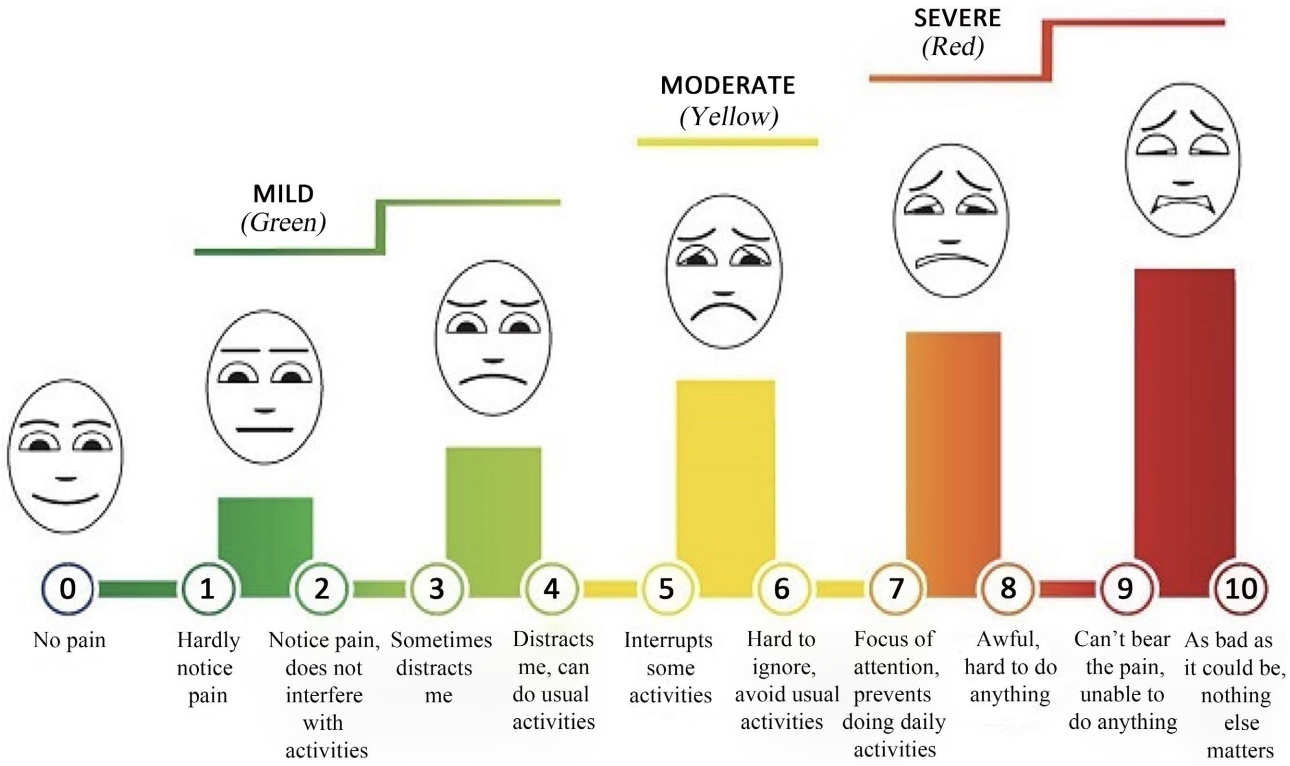

Figure 1. Pain scale.

3.3. Migraine Triggers Reported

Participants endorsed multiple physiological and environmental triggers (Table 2). The most prevalent triggers were stress/anxiety (95%; 19/20), followed by bright lights (80%; 16/20), hormonal fluctuations (75%; 15/20), weather changes (75%; 15/20), and lack of sleep (60%; 12/20). This trigger profile aligns with known migraine sensitization pathways involving autonomic instability and heightened cortical responsiveness to internal and external stressors.

Table 2. Migraine triggers reported by participants.

Triggers	of 20	%
Stress/Anxiety	**19**	**95%**
Bright Lights	**16**	**80%**
Hormonal Changes	**15**	**75%**
Weather Changes	**15**	**75%**
Lack of Sleep	**12**	**60%**

3.4. Migraine Symptoms

Baseline symptom burden was high and multisystemic (Table 3). Nearly all participants reported throbbing/pulsating pain (19/20), light sensitivity (19/20), and difficulty concentrating (19/20). Autonomic and musculoskeletal symptoms were also prominent, including nausea (16/20) and neck pain (16/20). Sensory hypersensitivity was reflected in sound sensitivity (15/20), visual aura (12/20), and dizziness (12/20). This constellation is consistent with chronic migraine, characterized by cortical hyperexcitability and widespread sensory dysregulation.

Table 3. Participants' symptoms reported prior to the study.

Symptoms	of 20
Throbbing/Pulsating	**19**
Light Sensitivity	**19**
Difficulty Concentrating	**19**
Nausea	**16**
Neck Pain	**16**
Sound Sensitivity	**15**
Aura (Visual Disturbance)	**12**
Dizziness	**12**

3.5. Medication Use and Complementary Modalities

Medication utilization patterns are summarized in Table 4. One participant reported use of three prescription migraine medications, seven reported two, nine reported one, and three reported no current prescription therapy. In addition, 18 of 20 participants reported prior use of non-pharmacologic or complementary approaches (e.g., massage, acupuncture, Botox injections, behavioral therapy), typically with limited or transient benefit. This extensive treatment history suggests that the sample was not treatment-naïve and reduces the likelihood that observed improvements were driven solely by novelty or expectancy effects.

Table 4. Number of prescription pharmaceutical medications currently used by participants.

# of Medications	
3	1
2	7
1	9
0	3

3.6. MIDAS (Migraine Disability Assessment) Results

The MIDAS instrument demonstrated marked reductions across all five disability domains. Mean scores decreased as follows:

1) Missed work/school days: 10.9 → 2.15.

2) Reduced productivity at work/school (≥50% reduction): 18.95 → 4.25 days.

3) Days of no household work: 16.67 → 3.95.

4) Reduced household productivity (≥50% reduction): 18.9 → 4.7 days.

5) Missed family, social, or leisure activities: 12.3 → 2.35 days.

Of particular note, 10 of 20 participants (50%) reported missing zero days after their first Neurogen session, despite the difference in assessment windows (90 days prior to the study vs 30 days in the post-intervention interval). A planned 90-day follow-up assessment will further clarify the durability of these gains.

Total MIDAS scores declined from a pre-study mean of 77.7, corresponding to Severe Disability (Grade IV), to a post-study mean of 16.5, corresponding to Moderate Disability (Grade III). This represents an approximate 79% reduction in migraine-related disability, supported by modeled estimates, MIDAS Grade Reference: Grade I (0 - 5): Little or no disability, Grade II (6 - 10): Mild disability, Grade III (11 - 20): Moderate disability, Grade IV (21+): Severe disability.

3.7. HIT-6 (Headache Impact Test) Results

Across all six HIT-6 items, pre/post reductions were strong and internally consistent:

1) *"When you have headaches, how often is the pain severe?"*

Mean item score decreased from 11.24 ("Very Often+") to 9.0 ("Rarely"); 13 of 20 participants improved, and 10 reported "Never" or "Rarely" at follow-up.

2) *"How often do headaches limit your ability to do usual daily activities?"*

Scores declined from 10.75 ("Sometimes+") to 8.95 ("Rarely"); 14 of 20 improved, with 9 reporting "Never" or "Rarely".

3) *"When you have a headache, how often do you wish you could lie down?"*

Scores decreased from 12.2 ("Very Often+") to 9.8 ("Rarely"); 13 of 20 improved, and 7 reported "Never" or "Rarely".

4) *"In the past 4 weeks, how often have you felt too tired to do work or daily activities because of your headaches?"*

Scores declined from 10.65 ("Sometimes+") to 8.6 ("Rarely"); 14 of 20 improved, and 12 reported "Never" or "Rarely".

5) *"In the past 4 weeks, how often have you felt fed up or irritated because of your headaches?"*

Scores decreased from 11.45 ("Very Often") to 8.9 ("Rarely"); 13 of 20 improved, and 11 reported "Never" or "Rarely".

6) *"In the past 4 weeks, how often did headaches limit your ability to concentrate on work or daily activities?"*

Scores declined from 10.85 ("Very Often") to 8.7 ("Rarely"); 17 of 20 improved, and 11 reported "Never" or "Rarely".

The total HIT-6 score decreased from 67.15, indicating Very Severe Impact, to 53.95, indicating Some Impact. A repeated-measures model confirmed that this reduction was statistically significant.

3.8. HIT-6 Impact Frequency Summary

When item responses were averaged, overall headache-related impact frequency shifted from 11.19 ("Very Often") before treatment to 9.0 ("Rarely") after the five NGBBMP sessions (Figure 2). This pattern suggests a broad neuromodulatory effect on the frequency with which headaches interfere with daily life.

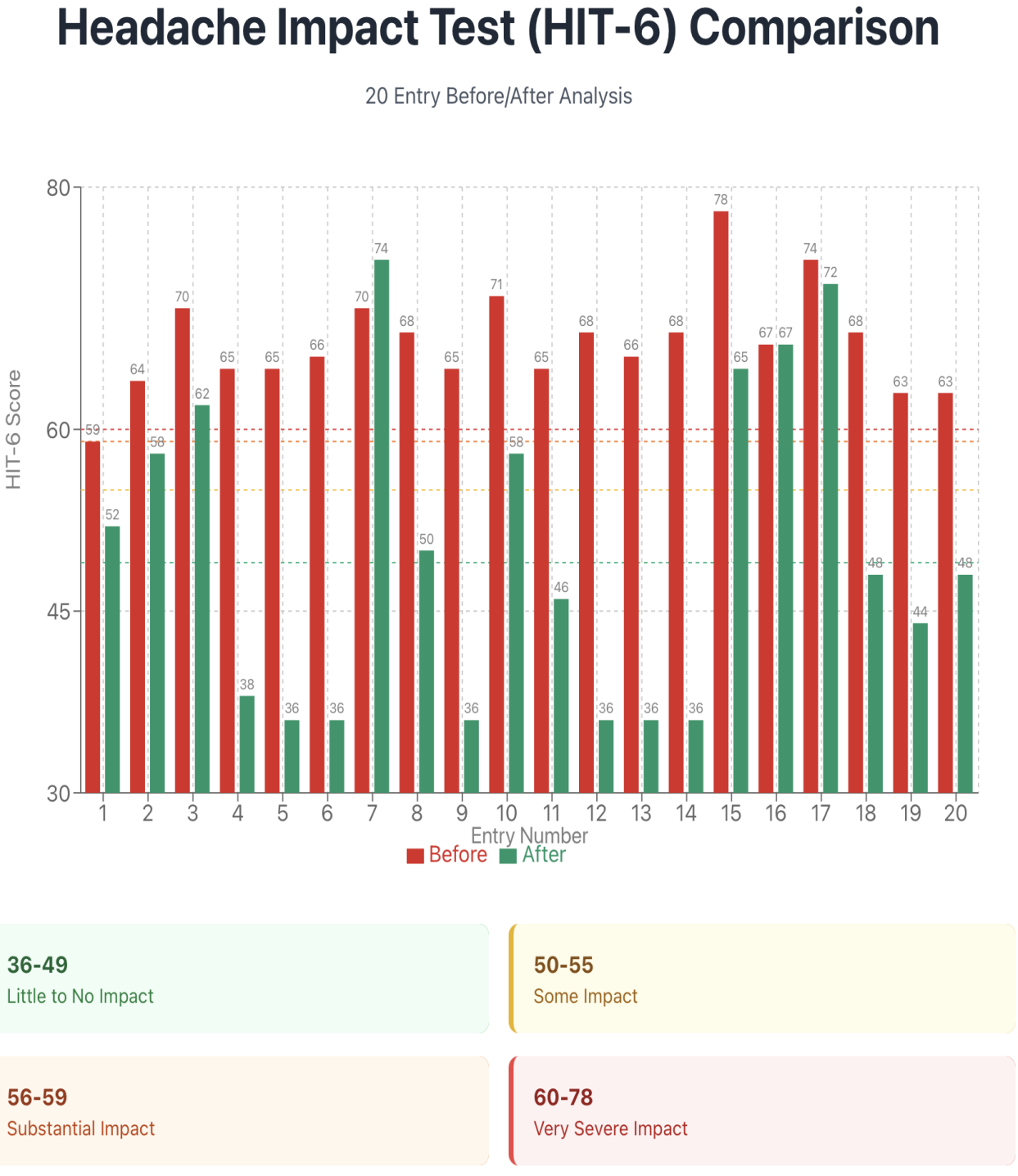

Figure 2. Headache Impact Test (HIT-6) comparison.

The Headache Impact Test (HIT-6) further illustrated a clinically meaningful shift in the frequency with which headaches interfered with daily life. The instrument asks respondents to rate six situations over the prior month—1) pain severity, 2) limitation of usual daily activities, 3) desire to lie down, 4) feeling too tired to work or perform daily tasks, 5) feeling fed up or irritated, and 6) difficulty concentrating—using a 5-point scale from "Never" to "Always", scored 6, 8, 10, 11, and 13 points, respectively. At baseline, the average item response was 11.19, corresponding to "Very Often" and placing the cohort in the "Very Severe impact" range (total score 60 - 78). Following NGBBMP, the average item response improved to 9.0, corresponding to "Rarely" and aligning with the "Some impact" category (total score 50 - 55). Thus, the protocol produced not only a numeric reduction in HIT-6 scores, but also a categorical shift from very frequent to infrequent headache-related interference across all six domains of daily functioning.

3.9. Quality of Life Results

Fifteen of twenty participants reported overall improvement in QOL during the four-week study period. Mean total QOL scores decreased from 3.64 ("Quite a Bit") to 2.0 ("Slightly"), representing an approximate 49% reduction in perceived life interference.

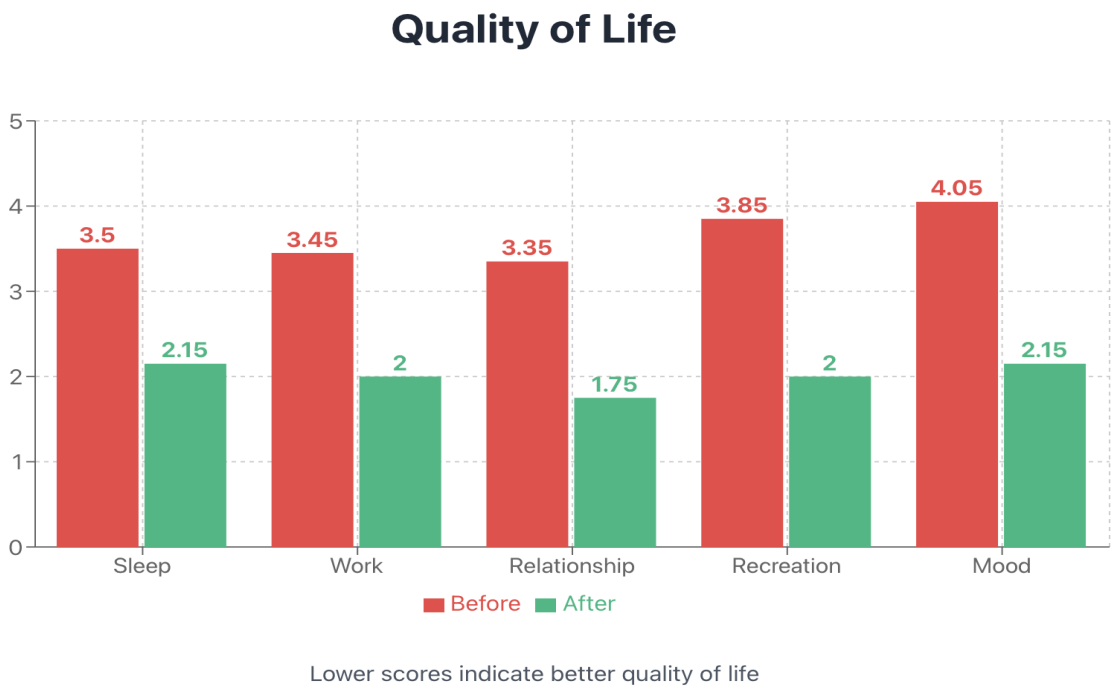

Figure 3. Quality of life self-ratings pre- and post-treatment.

Domain-specific changes (**Figure 3**) were as follows:

1) Sleep: 3.5 → 2.15 (57% improvement; 13/20 improved).

2) Work/School functioning: 3.45 → 2.0 (42% improvement; 14/20 improved).

3) Relationships: 3.35 → 1.75 (48% improvement; 16/20 improved).

4) Recreation: 3.85 → 2.0 (49% improvement; 15/20 improved).

5) Mood: 4.05 → 2.15 (47% improvement; 18/20 improved).

Mixed-effects modeling confirmed a significant pre/post change in overall QOL.

3.10. Treatment Goal Importance and Goal Achievement Ratings

Participants completed two structured Likert-scale assessments evaluating their priorities for treatment and their perceived progress following completion of the Neurogen Brain Balancing Migraine Protocol (NGBBMP). Each scale ranged from 1 to 5, with 1 indicating *Not important*/*Not achieved* and 5 indicating *Completely important*/*Completely achieved*.

Before beginning treatment, participants rated the importance of six therapeutic goals. These included: reducing migraine frequency, reducing migraine intensity, reducing migraine duration, improving daily functioning, reducing medication dependence, and improving sleep quality. All six goals were consistently ranked as highly important (ratings of 4 - 5), reflecting strong participant prioritization of both symptomatic relief and broader functional and lifestyle outcomes.

Following the five-session neuromodulation protocol, participants rated the degree to which each corresponding treatment goal had been achieved. Using the same 1 - 5 scale, participants evaluated progress toward: reduced migraine frequency, reduced migraine intensity, reduced migraine duration, improved daily functioning, reduced medication dependence, and improved sleep quality. Responses indicated meaningful perceived improvements across all six domains, with many participants endorsing scores in the "mostly achieved" to "completely achieved" range (4 - 5). These post-treatment ratings provide subjective but clinically relevant evidence that participants experienced therapeutic gains aligned with their pre-treatment priorities.

Participants rated the importance and achievement of six treatment goals (Table 5). Pre-study importance ratings (1 - 5 scale) were uniformly high:

1) Reduced migraine frequency: $M = 4.6$.

2) Reduced migraine intensity: $M = 4.6$.

3) Reduced migraine duration: $M = 4.25$.

4) Improved daily functioning: $M = 4.6$.

5) Reduced medication dependence: $M = 3.95$.

6) Improved sleep quality: $M = 3.9$.

Post-study goal-achievement ratings showed substantial progress:

1) Frequency: $M = 3.35$, with 12 of 20 participants rating achievement 4 - 5.

2) Intensity: $M = 3.4$, 12 of 20 rated 4 - 5.

3) Duration: $M = 3.35$, 11 of 20 rated 4 - 5.

4) Daily functioning: $M = 3.9$, 12 of 20 rated 4 - 5.

5) Medication dependence: $M = 3.25$, 11 of 20 rated 4 - 5.

6) Sleep quality: $M = 3.3$, 9 of 20 rated 4 - 5.

Across all items, 56% of goal-achievement responses fell in the 4 - 5 range, indicating that more than half of all stated objectives were rated as "mostly" or "completely" achieved.

Table 5. Participants' self-rated goals and the level these goals were achieved.

	Goal Description	Before Study Level of Importance	Goal Achieved? Completely = 5 Not = 1	Rated as 5 or 4
Goal 1	Frequency	4.6	3.35	12 of 20
Goal 2	Intensity	4.6	3.4	12 of 20
Goal 3	Duration	4.25	3.35	11 of 20
Goal 4	Daily Function	4.6	3.9	12 of 20
Goal 5	Med Dependency	3.95	3.25	11 of 20
Goal 6	Sleep Quality	3.9	3.3	9 or 20
				56% = Goal achieved

3.11. Overall Effectiveness Ratings

Participants also provided a single global rating of NGBBMP effectiveness on a 0 - 10 scale (0 = no improvement, 10 = complete resolution). The mean overall effectiveness rating was 6.7/10, and 60% of participants (12/20) rated effectiveness at 7 or higher, indicating a generally favorable global impression. See Table 6.

Exploratory review of lower ratings suggested meaningful clinical nuance. Six of the eight participants who rated effectiveness ≤ 5 had migraine histories of ≥10 years, suggesting that longer-duration illness may require additional sessions or extended protocols. One participant who rated effectiveness as "1" had a known vascular restriction in a cervical vein, with surgery scheduled; this comorbid condition likely constrained their responsiveness to neuromodulation.

Table 6. Participants' self-ratings of NGBB migraine protocol effectiveness.

Overall Effectiveness Rating	# of Participants Who Scored (out of 20)
10	4
9	4
8	2
7	2
6	0
5	2
4	2
3	3
2	0
1	1

3.12. Effect Sizes and Percent Change Analysis

Effect size calculations indicated extremely large pre/post changes across all principal outcome domains.

1) MIDAS: Cohen's d = 4.61 (extremely large effect).

2) HIT-6: Cohen's d = 8.32 (extremely large effect).

3) QOL: Cohen's d = 6.75 (extremely effect).

Percent change analyses further characterized the magnitude of the benefit:

1) MIDAS domains showed 75% - 81% reductions in missed or low-productivity days across work/school, household tasks, and social/leisure activities.

2) HIT-6 items improved by 17% - 22%, with a categorical shift in total score from Very Severe Impact to Some Impact.

3) QOL domains improved by 39% - 50%, with the largest relative gains in sleep, recreation, and mood.

These effect sizes and percent changes are markedly larger than those typically reported in behavioral or pharmacologic migraine trials, suggesting a strong neuromodulatory signal associated with the NGBBMP.

3.13. Written Reports from the Participants Gathered during and after the Study

In Table 7, A qualitative content analysis was conducted on the 15 verbatim comments using an inductive thematic approach consistent with standard qualitative research methods, drawing on the framework described by Braun and Clarke (2006) for reflexive thematic analysis [25]. Comments were reviewed repeatedly, coded line by line, and grouped into emergent themes based on patterns of meaning expressed across participants. This method allowed themes to arise directly from the data rather than being imposed a priori, ensuring that the analysis remained grounded in participants' experiences.

Across the comments, a dominant theme emerged involving a substantial reduction or complete cessation of migraines. Eleven of the 15 individuals described either no migraines or a marked decrease in frequency, with several noting that this was the longest period without a migraine in years. A related theme involved reductions in migraine intensity and hastened recovery; multiple participants reported that when migraines did occur, they were milder and resolved more quickly, sometimes within the same day rather than persisting overnight. Improvements in sleep were also frequently reported, with ten participants describing deeper sleep, faster sleep onset, and waking more refreshed. Many further noted enhanced mood, mental clarity, better focus, or improved memory following the sessions. Some participants described increased tolerance to typical migraine triggers such as headlights, strong odors, or weather changes, suggesting greater neurological resilience. Functional improvements were also common, with individuals mentioning increased productivity, reduced need for medication, and the ability to resume activities previously limited by migraines. Many comments reflected emotional relief, gratitude, and a sense of regained control or hopefulness. Only two participants reported minimal or mixed changes, such as

increased headaches during the study period or little noticeable change yet, a variation consistent with natural differences in treatment response among migraine sufferers.

Overall, the inductive thematic analysis showed that the majority of participants experienced meaningful improvements across multiple domains, including symptom frequency, severity, sleep quality, emotional well-being, and functional capacity. The qualitative results closely aligned with the quantitative outcomes and provided rich, contextual insight into the lived experiences of those undergoing EEG neuromodulation for migraine relief.

Table 7. Thematic analysis of qualitative results.

Theme	Number of Comments (n = 15)	Percentage
Reduction or Cessation of Migraines	11	73%
Reduced Intensity/Faster Recovery	6	40%
Improved Sleep	10	67%
Improved Mood, Focus, and Cognition	7	47%
Increased Tolerance to Triggers	3	20%
Functional Improvements	8	53%
Emotional Relief/Regained Hope	9	60%
Minimal or Negative Change	2	13%

The following quotes are verbatim comments from 15 of the 20 participants:

"Before the sessions, I was even afraid to fall asleep and would often wake up with a severe migraine. Since the last session, I haven't had a migraine probably for the longest period in the past three years."

"I had more headaches the last 3 weeks than usual. Energy and sleep was improved but headaches were definitely more frequent."

"Although it hasn't completely gotten rid of my migraines and headaches, I have noticed a huge difference if the [sic] intensity and duration of them. I feel like I am able to rid [sic] of them way quicker, which is such a relief. I will continue the treatments."

"I have not had a Migraine since the study started."

"There was a small change to my migraines since the study. I would say the most significant thing was that if I had a migraine start in the morning I was able to get rid of it by the end of the day instead of going to bed with it and hoping it would be gone by morning. I did notice that I am able to fall asleep quicker and stay asleep. I am not woken up as much."

"No migraine yet so hard to report change."

"Headache and pain free today, feel more open minded with every session, sleeping much deeper wake up feeling rested, my memory is better then [sic] before."

"This has helped. Thank you for this treatment. It helped more than I could have expected."

"4 out of 5 days, my head felt better after the session."

"Before I began this treatment, I had a migraine pretty much every other day, at least 5 days out of the week. By the second visit, I had one migraine, which was very weird. I felt amazing. On my 3rd visit, I walked in with a migraine really doubtful it would help me but it worked I went in feeling my worst thinking of going into the ER instead but I gave it a shot and I don't regret it one bit I was pain free after the appointment and got so much done in the day I'd usually wouldn't be able to especially without taking medication."

"I've had 1 dull headache since staring [sic] the study. My sleep has improved and so has my mood. Additionally, the pain in my neck that I often felt has since dissipated."

"It reduced my side effects to Ajovy."

"I used to experience 5 - 9 migraines lasting 4+ hours each, but now I've only had one that lasted less than 2 hours. After each session, I noticed improvements in my sleep, focus, and overall relaxation. I also feel that this treatment has helped reduce some of my anxiety. Additionally, I can now be around common triggers—like strong smells and weather changes—without immediately experiencing a migraine."

"Been amazing sleeping like a baby still and still no headaches or migraines!!! And head lights don't hurt in the mornings going to work!!!!"

"Well today marks 3 years since my 4th concussion that started causing severe migraines. The past three years I definitely had to fight through the hard migraines until they were unbearable. Many doctor visits, chats and more that just never went anywhere. So many things I had to leave early due to driving in the dark hurt my eyes and started one, loud noises/events I struggled with, I struggled but didn't want my migraines and concussions to win and have to stop my life events due to them but also it just got to [sic] much most days…. So just last week I had the chance to fly down to Maryland to have brain balancing done to hopefully decrease the migraines and the pain (last photos). Was the best four days, It's now being a week since my first treatment I have yet to have a migraine and I've been sleeping amazing and everything that used to make a migraine come on hasn't. I definitely feel like my life back and couldn't be happier."

After the completion of the study, the participants wrote the following comments:

Follow-up qualitative review was conducted using the same inductive thematic analysis approach described by Braun and Clarke (2006) [25]. These comments were gathered after participants had completed the full four-week neuromodulation protocol and had returned to their normal routines. The analysis revealed a strong pattern of continued improvement in migraine burden, with most individuals reporting sustained or further reduced migraine activity beyond the treatment window.

Several participants described ongoing decreases in migraine frequency, with statements such as:

"I'm so happy to report that my migraine frequency and intensity have gotten way better" and "I have had barely any headaches and no migraines".

Others described near-complete remission with additional functional gains, such as being able to drive at night without triggering symptoms. Some reported that while occasional headaches still occurred, they did not progress into full migraines, which was noted as highly unusual compared to their pre-study baseline. Improvements in sleep quality continued to emerge as a recurring theme, with one participant reporting "the best week of sleep ever" following the study period, and another emphasizing "Still getting great sleep" (even when mild headaches appeared).

A minority of participants noted some recurrence of headaches in the weeks following travel or poor sleep, though even these comments emphasized that the overall pattern remained significantly improved compared to before treatment. As one participant summarized, headaches had returned but were "still a lot better than before", and improvements seemed to reflect a combination of brain balancing and better sleep patterns.

Overall, the post-study comments demonstrate that many participants experienced sustained benefits beyond the treatment period, including reduced frequency and severity of migraines, prevention of migraine progression when headaches did occur, improved sleep quality, and enhanced daily functioning. These follow-up responses support the possibility of both short-term and longer-lasting neuromodulatory effects.

1) *"Hello I still get them but not so frequent anymore. It's been alot better since the study!"*

2) *"Very good. Minimal headaches and no migraines. And that was in the past 2 weeks after it's been awhile since treatment I'm due a tune up."*

3) *"Hi!! I'm so happy to report that my migraine frequency and intensity has gotten way better. I think I've only had two migraines since completing the study."*

4) *"Had a headache the other day but it never turned into a migraine which is very uncommon for me. was manageable still haven't had a migraine yet and still getting great sleep."*

5) *"Hello!, just wanted to check in been amazing since been home, no headaches or migraines which I should have gotten plenty by now. last night I drove in the dark on the way to nh from ct and no problems and left amazing."*

6) *"It's going well! I have had barely any headaches and no migraines."*

7) *"Sorry for the late reply, been busy working on Christmas orders! In France I had a few bad days, but overall felt pretty good. When we got home I took some natural pills to help me sleep and I had the best week of sleep ever…and also a couple weeks my best head weeks ever. It was so great. I'm not sleeping as well now and my headaches are back but still I'd say a lot better than before. I do think it is*

a combo of the brain balancing and better sleep."

Follow-Up Theme	Number of Comments (n = 7)	Representative Verbatim Example
Sustained reduction or absence of migraines	6	"No headaches or migraines, which I should have had plenty of by now."
Fewer headaches that do not progress into migraines	3	"Had a headache the other day, but it never turned into a migraine, which is very uncommon for me."
Continued improvement in frequency and intensity	5	"My migraine frequency and intensity have gotten way better. I think I've only had two migraines since completing the study."
Improved sleep quality	4	"Still getting great sleep."
Improved ability to tolerate triggers (e.g., driving at night).	1	"Drove in the dark… no problems."
Temporary symptom return related to travel or poor sleep.	1	"Had a few bad days in France… headaches are back, but still a lot better than before."
Desire for periodic maintenance ("tune-up")	1	"It's been a while since treatment—I'm due for a tune-up."

3.14. 90-Day Post-Protocol Follow-Up Outcomes

To evaluate the persistence of treatment-associated changes beyond the immediate post-intervention window, participants were invited to complete a voluntary 90-day follow-up assessment (**Appendix E**). Nine of the twenty enrolled participants (45%) provided follow-up data. Interpretation of these findings warrants caution, given the response rate; however, the distribution of outcomes demonstrated notable directional consistency.

At follow-up, eight of nine respondents (89%) reported that their migraines were less frequent relative to baseline. One respondent (11%) reported migraine frequency comparable to baseline. Importantly, no respondents reported worsening migraine frequency. Similar patterns were observed across additional symptom dimensions. Seven respondents (78%) reported reduced migraine intensity, while two respondents (22%) reported intensity levels consistent with baseline. Seven respondents (78%) further reported that migraines were less painful, whereas two respondents (22%) reported no meaningful change. No respondents endorsed increased intensity or painfulness.

Assessment of headache burden during the final three weeks preceding follow-up revealed that the majority of respondents clustered within a minimal symptom range. Seven of nine respondents (78%) reported experiencing only 0 - 2 migraine or headache days. One respondent (11%) reported five headache days, and one respondent (11%) reported higher frequency. This distribution suggests that reductions in migraine activity were largely maintained for most respondents during the weeks immediately preceding evaluation.

Pain severity ratings exhibited a similarly favorable distribution. Average pain

ratings fell exclusively within the mild-to-moderate range (1 - 6 on a 10-point scale). Notably, no respondents endorsed severe pain ratings (7 - 10). The absence of high-severity pain reports suggests attenuation of peak symptom intensity rather than solely reductions in episode frequency.

Treatment satisfaction remained high among respondents. Five of nine participants (56%) reported being very satisfied with outcomes, three (33%) reported satisfaction, and one (11%) reported a neutral experience. No respondents reported dissatisfaction. Reported side effects remained limited, with five respondents (56%) indicating no side effects and four (44%) reporting only mild or transient effects. No moderate or severe delayed adverse events were observed.

Although exploratory and constrained by sample size, the 90-day follow-up findings demonstrated several quantitative characteristics consistent with sustained clinical improvement. These included high proportions of respondents reporting reductions across migraine frequency, intensity, and painfulness domains; clustering within minimal headache burden ranges; downward shifts in pain severity distributions; and absence of reported symptom worsening. While causal inferences cannot be drawn, the directional stability and internal coherence of responses support the presence of a preliminary durability signal.

4. Discussion

The findings of this study indicate that the Neurogen Brain Balancing Migraine Protocol (NGBBMP) produced broad, meaningful, and rapid improvements in migraine severity, daily functioning, and quality of life among individuals with long-standing, clinically diagnosed migraine. Most participants had suffered for a decade or more and had already tried multiple pharmacologic and complementary approaches with only partial or transient relief. In many ways, this cohort reflects the patients commonly seen in clinical practice: people who have slowly reorganized their lives around pain, triggers, and unpredictability, and who often feel discouraged by the slow or incomplete benefits of standard treatments.

Against this clinical backdrop, the magnitude and speed of improvement observed after only five 30-minute noninvasive neuromodulation sessions are striking. Participants reported large reductions in disability on the MIDAS, a categorical shift on the HIT-6 from "Very Severe" to "Some" impact, and nearly 50% improvement across multiple quality-of-life domains. These findings suggest that NGBBMP may be engaging core neural mechanisms that sustain chronic migraine and support the brain's innate capacity for self-regulation and healing, even when dysregulation has been present for many years [26] [27].

Migraine is increasingly recognized as a whole-brain, whole-body disorder of network instability rather than a simple vascular or episodic pain phenomenon [26] [28] [29]. The present results—spanning pain intensity, functional interference, mood, sleep, and goal attainment—are consistent with a model in which NGBBMP acts on large-scale neural systems involved in sensory gating, thalamocortical communication, pain modulation, autonomic regulation, and neuroplastic-

ity [30] [31].

4.1. Why Neuromodulation Is So Effective in Migraine: A Mechanistic Perspective

Chronic migraine is increasingly understood as a disorder of dysregulated brain networks, sensory hypersensitivity, and central nervous system overdrive rather than an isolated vascular event [27] [28]. Traditional medications primarily target downstream biochemical mediators of pain, whereas neuromodulation seeks to recalibrate the underlying circuitry that shapes attack vulnerability, symptom amplification, and chronicity. The mechanisms summarized below are supported by existing literature and are consistent with the clinical pattern observed in this study.

4.1.1. Reducing Cortical Hyperexcitability

Migraine is increasingly understood as a disorder of cortical hyperexcitability and abnormal thalamocortical rhythms. Neurophysiologic and imaging studies consistently show that individuals with chronic migraine are associated with heightened excitability in the visual, auditory, and somatosensory cortices compared with non-migraine controls [28] [32]. EEG studies demonstrate increased gamma and high-beta activity during interictal phases, reflecting heightened neuronal firing and sensory amplification. Low-intensity electrical stimulation has been shown to normalize aberrant oscillations and reduce cortical excitability by shifting membrane potentials and modulating ion channel function [1] [5]. This "sensory high-alert" state lowers the threshold for triggers such as light, sound, stress, and hormonal change, and can prime the system for repeated attacks. Neuromodulation may downshift this elevated cortical tone, increasing inhibitory control and allowing the brain to disengage from a chronic threat-detection loop. Clinically, this reduction in hyperexcitability is reflected in decreased sensitivity to light and sound, fewer attacks, and less perceived overwhelm—outcomes that were frequently reported by participants in the present study.

4.1.2. Restoring Thalamocortical Rhythms

The thalamus plays a central role in filtering sensory input and coordinating rhythmic communication with cortical regions. In migraine, thalamocortical oscillations become disrupted, contributing to abnormal sensory gating, attentional disturbances, and amplification of nociceptive signals [30]. By providing patterned stimulation, neuromodulation may help re-synchronize these rhythms, improving the efficiency and stability of information transfer between the thalamus and cortex. The improvements seen here in concentration, irritability, and overall cognitive steadiness are consistent with the partial normalization of thalamocortical dynamics.

4.1.3. Interrupting Central Sensitization

Central sensitization—enhanced responsiveness of central nociceptive pathways—is a hallmark of chronic migraine [26] [29]. It engages the insula, anterior cingu-

late cortex, and brainstem pathways, amplifying responses to painful and non-painful stimuli. Once this pattern is established, the nervous system becomes "primed" to interpret many inputs as threatening or painful. Neuromodulation may disrupt these sensitized networks, lowering the gain on pain signals and allowing the system to "unlearn" habitual hypervigilance. The robust reductions in MIDAS scores and the shift from "Very Severe" to "Some" impact on the HIT-6 suggest that NGBBMP may be acting on these central sensitization processes.

4.1.4. Modulation of Neuroinflammation

Neuroinflammation plays a critical role in migraine chronification through cytokine release, glial activation, and trigeminovascular sensitization. Emerging evidence shows that weak electrical stimulation can attenuate neuroinflammatory signaling, reduce microglial activation, and stabilize blood-brain barrier dynamics [3]. These effects may reduce central sensitization, a hallmark of chronic migraine, and contribute to improvements in photophobia, headache intensity, and pain persistence observed in early case reports. Reductions in headache intensity, photophobia, and overall migraine burden observed in this study are consistent with NGBBMP-mediated attenuation of neuroinflammatory signaling and decreased central sensitization.

4.1.5. Balancing Autonomic Nervous System Activity

Migraine attacks are associated with dysregulated autonomic activity, including sympathetic overactivation and impaired parasympathetic tone. Individuals with migraine frequently exhibit dysregulated autonomic function, including sympathetic overactivation and reduced parasympathetic tone [29]. This imbalance can manifest as sleep disturbance, fatigue, irritability, and vulnerability to stress—features widely reported by people living with chronic migraine. Neuromodulation that targets central regulatory networks has been shown to enhance vagal activity and promote a more balanced autonomic profile [29]. By influencing limbic and prefrontal circuits involved in autonomic control, neuromodulation can shift the system toward parasympathetic dominance, reducing stress reactivity and enhancing resilience [7] [8]. Participants in this study reported improvements in sleep quality, anxiety, emotional regulation, daytime energy, and irritability—domains tightly linked to autonomic function and known to influence migraine thresholds—suggesting that NGBBMP may support autonomic rebalancing in addition to modulating pain networks.

4.1.6. Supporting Neuroplasticity and Network Flexibility

Neuroplasticity—the brain's ability to reorganize connections in response to experience—is fundamental to both the development and the resolution of chronic pain. Noninvasive brain stimulation has been shown to modify synaptic efficacy, influence long-range connectivity, and alter network dynamics in ways that persist beyond the period of stimulation [31]. The microcurrents delivered during LIP-tES engage mechanisms similar to those observed in low-intensity transcranial direct and alternating current stimulation. These include LTP- and LTD-like

synaptic modulation, NMDA receptor engagement, and BDNF-mediated plasticity [2] [6]. Repeated NGBBMP sessions may therefore reinforce healthier connectivity patterns while weakening maladaptive ones, progressively reducing the intensity and unpredictability of migraine episodes. The sustained and multidimensional improvements observed over the four-week period are consistent with such plastic changes.

Taken together, these mechanisms provide a coherent, biologically plausible explanation for the rapid and widespread benefits observed in this study. They also frame migraine not as a fixed defect but as a modifiable network condition, which is both scientifically and psychologically empowering for patients and clinicians [26] [28]. By promoting conditions favorable to neuroplastic rearrangement, NGBB may support healthier long-range connectivity within networks implicated in pain processing, including the default mode network, salience network, and descending pain inhibitory systems.

4.1.7. Restoration of Network Homeostasis

Chronic migraine involves large-scale network dysregulation rather than a localized dysfunction. Neuromodulation studies suggest that ultra-low-intensity electrical signaling can reorganize whole-brain connectivity, increasing efficiency and coherence across pain-processing networks [4]. By working at the network level rather than attempting to suppress symptoms, NGBB may help restore baseline homeostasis across cortical, limbic, and autonomic circuits, underpinning rapid symptom improvements observed in some participants.

4.1.8. Rapid Observable Neurophysiological Changes

Case reports within the Neurogen system show rapid EEG normalization, including reduced gamma hyperactivation, improved hemispheric symmetry, and stabilization of overactive cortical regions. These rapid neuroelectric responses align with findings from transcranial direct current stimulation (tDCS) and transcranial alternating current stimulation (tACS) studies demonstrating that low-intensity current can produce immediate shifts in cortical firing rates and entrainment patterns. Through algorithm-guided microcurrent delivery, NGBB interrupts entrenched maladaptive patterns and pushes hyperactive networks toward normative oscillatory states.

4.1.9 Durability of Observed Effects at 90-Day Follow-Up

The exploratory 90-day follow-up findings provide preliminary insight into the persistence of treatment-associated changes following completion of the Neurogen Brain Balancing Migraine Protocol (NGBBMP). Although limited by voluntary response and modest sample size, the distribution of outcomes demonstrated a notable pattern of directional stability across multiple migraine-related domains.

Among respondents, the majority reported sustained reductions in migraine frequency, intensity, and painfulness. Importantly, no respondents endorsed worsening symptoms across these primary dimensions. This absence of reported dete-

rioration is clinically relevant, as chronic migraine populations typically exhibit fluctuating or relapsing symptom trajectories over comparable time intervals. In untreated or partially responsive populations, regression toward baseline symptom burden is commonly observed following cessation of active intervention. The stability of improvement signals observed here suggests that the effects associated with the protocol may extend beyond transient symptomatic modulation.

A particularly meaningful observation involved the distribution of pain severity ratings. Average pain scores remained confined to the mild-to-moderate range, and severe pain ratings were absent at follow-up. From a neurophysiological perspective, attenuation of peak symptom intensity may represent an important marker of altered network dynamics. Chronic migraine is characterized not only by increased attack frequency but also by amplification of pain-processing pathways, cortical hyperexcitability, and central sensitization. Reductions in the upper bound of pain experience—sometimes described as "severity compression"—have been associated in neuromodulation literature with normalization of excitability thresholds and reduced nociceptive amplification rather than simple analgesic effects.

The clustering of respondents within minimal headache burden ranges further supports this interpretation. Most participants reported experiencing a few migraine or headache days during the weeks immediately preceding assessment. While self-report measures cannot fully eliminate expectancy or recall biases, random variation alone would be expected to produce more heterogeneous distributions, including mixed patterns of improvement and worsening. Instead, the data exhibited cross-domain coherence, with frequency, intensity, and painfulness measures shifting in a concordant direction.

Several mechanistic explanations may account for the observed durability pattern. Neuromodulation approaches are hypothesized to influence migraine pathophysiology through modulation of cortical excitability, stabilization of thalamocortical rhythms, attenuation of central sensitization, and enhancement of neuroplastic regulatory processes. Unlike purely symptomatic interventions, network-level modulation may produce effects that persist beyond the stimulation period by altering functional connectivity, excitability thresholds, and autonomic regulatory balance. The qualitative follow-up comments describing headaches that failed to progress into full migraine episodes are consistent with this possibility and may reflect modification of attack dynamics rather than elimination of symptoms alone.

At the same time, variability among respondents warrants careful consideration. A subset of participants reported partial improvement, occasional headache recurrence, or perceived need for maintenance sessions. Such heterogeneity is consistent with the known clinical complexity of chronic migraine, which involves multifactorial drivers including genetic susceptibility, neuroinflammatory processes, autonomic dysregulation, sleep disturbances, and comorbid pain conditions. The presence of partial responders does not negate the broader durability signal but highlights the potential importance of individualized treatment dosing

and maintenance paradigms.

Interpretation of these findings must remain conservative. The response rate introduces the possibility of response bias, as individuals experiencing greater benefit may have been more likely to complete follow-up assessments. Additionally, the absence of a control or sham comparison prevents causal attribution. Nevertheless, the internal consistency, absence of worsening reports, downward shift in pain severity distribution, and concordant improvements across domains collectively support further investigation.

Future randomized controlled trials incorporating predefined follow-up intervals, objective headache diaries, and neurophysiologic biomarkers will be essential to more definitively characterize treatment durability, maintenance dynamics, and relapse patterns. The present findings should therefore be viewed as hypothesis-generating evidence suggesting that passive EEG-guided neuromodulation may produce effects that persist beyond the active treatment window in at least a subset of chronic migraine sufferers.

4.2. The Human Value of Neuromodulation: Practical, Accessible, and Empowering

Beyond its mechanistic appeal, neuromodulation carries several practical and human-centered advantages. NGBBMP is noninvasive, well-tolerated, and does not introduce a systemic pharmacologic burden [31]. Sessions are brief, require no downtime, and can be integrated alongside existing medication regimens, behavioral therapies, and lifestyle interventions. For individuals who have experienced side effects, contraindications, or diminishing returns from medications, neuromodulation offers an alternative pathway that does not rely on additional drugs.

A particularly meaningful feature of NGBBMP is the short therapeutic latency. Many preventive medications require weeks to months for titration and stabilization, and patients often must endure prolonged uncertainty while waiting to see whether a given regimen will help [27]. In this study, measurable benefits were observed after the first session for many participants, and substantial improvements were seen within four weeks. For people whose work, relationships, and sense of self are continually disrupted by migraine, this rapid onset of relief can restore hope and engagement in their own healing process.

From a health-systems perspective, a nonpharmacologic intervention that is safe, scalable, and capable of reducing disability has clear appeal. From a patient perspective, it offers something equally valuable: an experience of care that feels calming, supportive, and restorative rather than invasive or destabilizing.

4.3. Expanding Applications: Neurogen as a Platform for Broader Conditions

Although the current study focused on migraine, the underlying principles of neuromodulation extend to other conditions characterized by network dysregulation, sensory hypersensitivity, or autonomic imbalance [26] [31]. The Neurogen platform

may be adaptable to several additional clinical populations.

4.3.1. Chronic Pain Conditions

Fibromyalgia, neuropathic pain, temporomandibular joint (TMJ) disorders, and other centralized pain syndromes share mechanisms of cortical hyperexcitability and central sensitization similar to those seen in migraine [26]. Modulating these networks may reduce widespread pain, fatigue, and cognitive fog in such populations.

4.3.2. Trauma, Stress, and PTSD

Post-traumatic stress and chronic stress states are associated with limbic overactivation, impaired prefrontal regulation, and autonomic dysregulation [27] [29]. By influencing limbic-prefrontal-autonomic circuits, neuromodulation may support emotional resilience, reduce hyperarousal, and improve clarity and presence for individuals with trauma-related conditions.

4.3.3. Sleep Disorders and Fatigue Syndromes

Because neuromodulation can enhance parasympathetic tone and improve network stability [29] [31], protocol adaptations may benefit individuals with insomnia, circadian rhythm disruption, or fatigue syndromes in which dysautonomia and impaired arousal regulation are prominent.

4.3.4. Cognitive Dysfunction and Post-Concussion Syndromes

Disruption of thalamocortical and frontoparietal networks is common in mild traumatic brain injury and post-concussion states [30]. Techniques that restore rhythmic communication and reduce network noise may help alleviate cognitive fog, slowed processing, and attentional deficits.

4.3.5. At-Risk and Special Populations

The noninvasive, low-risk nature of NGBBMP positions it well for use in military service members with blast injuries, chronic headache, or PTSD; healthcare workers and caregivers exposed to chronic stress; underserved communities with limited access to expensive biologic therapies; and adolescents or young adults for whom nonpharmacologic options are particularly desirable [9] [27].

Future research should systematically evaluate feasibility, optimal dosing, long-term outcomes, and necessary protocol adaptations across these diverse groups.

4.4. Considerations for Future Research and Development: Broader Healthcare Systems Integration

An ongoing pilot study at VA Boston, funded by a $230,000 Small Projects in Rehabilitation Research (SPiRE) grant, is evaluating the feasibility and effectiveness of low-intensity pulse-based transcranial signaling (LIP-tES) for managing photosensitivity in veterans with mild traumatic brain injury (mTBI). The study, which is currently recruiting participants on ClinicalTrials.gov, incorporates resting-state MRI scans to assess neurophysiological changes following the intervention, with an estimated completion date of November 2026. Based on preliminary

data, anecdotal reports, and observed improvements, Neurogen™ technology has demonstrated promise in managing photosensitivity, post-concussion symptoms (including memory, concentration, and irritability issues), and headaches. If validated, this modality could reduce reliance on medication and enhance the quality of life for veterans suffering from neurological impairments. With these promising applications, further research into targeted neurological rehabilitation, post-TBI symptom management, and broader clinical applications is warranted.

To further establish the efficacy of Neurogen Brain Balancing (NGBB), future research should prioritize randomized, double-blind, placebo-controlled trials to rule out non-specific treatment effects and confirm the direct neurological impact of the intervention. Additionally, longitudinal studies spanning 6 to 12 months would help assess the sustainability of therapeutic benefits and determine whether repeated sessions lead to cumulative improvements in brain function and symptom relief.

Incorporating objective biomarkers such as functional MRI (fMRI), heart rate variability (HRV), salivary cortisol levels, and quantitative EEG (qEEG) data would provide valuable physiological evidence of neurobiological changes induced by NGBB. QEEG sampling, in particular, could help validate the modality's effects on brainwave normalization, neural connectivity, and neuroplastic adaptations over time. This would help bridge the gap between subjective self-reports and objective neurological improvements, reinforcing the scientific foundation of this modality.

Further research should also investigate potential synergies between NGBB and other evidence-based interventions, such as cognitive-behavioral therapy (CBT), mindfulness practices, biofeedback, or structured exercise regimens. A multimodal approach could enhance therapeutic outcomes, particularly for individuals with complex neurological and psychological conditions.

Moreover, broadening research efforts to include diverse populations—such as civilians, first responders, and individuals with neurodegenerative diseases—would provide insight into the broader applicability of NGBB beyond the veteran community. Special consideration should also be given to special-needs populations, including individuals with autism spectrum disorder (ASD), developmental delays, and chronic conditions that have otherwise been resistant to conventional treatment. The potential for NGBB to improve self-regulation, executive function, and sensory processing in ASD is particularly promising, given its passive and non-invasive nature. Additionally, research into chronic pain conditions, autoimmune disorders, and treatment-resistant neurological conditions could further demonstrate NGBB's versatility as a neurotherapeutic intervention.

4.4.1. ECM and Pathophysiology of Migraine: Future Research with Neurogen

Future research on Neurogen Brain Balancing (NGBB) and low-intensity pulse-based transcranial signaling (LIP-tES) could further integrate the Eight-Circuit Model of Consciousness (ECM) as a translational neurodevelopmental framework

for understanding large-scale brain networks, developmental neurobiology, and functional symptom patterns such as migraine to investigate its impact on neuroplasticity, cognitive flexibility, and subjective well-being. The ECM identifies eight "circuits" or dimensions of consciousness—the lower four circuits relate to typical stages of development throughout the human lifespan, and the upper circuits map transpersonal and psychospiritual states [33]. Beyond its philosophical implications, the model may serve as a clinically useful heuristic for organizing neurophysiological data across hierarchical brain systems.

A multi-stage research framework is recommended, beginning with baseline neurophysiological mapping using qEEG, fMRI, and HRV to evaluate pre- and post-treatment changes in brain activity, including large-scale brain network dynamics. Particular attention could be directed toward Default Mode Network (DMN), Salience Network (SN), Central Executive/Fronto-Parietal Network (FPN), limbic circuitry, and thalamocortical oscillatory loops. These networks may be conceptualized as functional correlates of various ECM circuits, allowing for a systems-level exploration of how neuromodulation influences hierarchical integration.

The initial research stage would examine NGBB's effects on lower circuits—in particular Circuit 1 (survival, attachment patterns, and autonomic regulation), Circuit 2 (emotional regulation and limbic conditioning), Circuit 3 (cognitive structuring and symbolic processing), and Circuit 4 (social conditioning and executive function dynamics), hypothesizing improved neural coherence and reduced dysregulation. Subsequent phases would correlate biometric data with subjective experiences, tracking shifts in sensory perception, behavioral adaptability, and emotional resilience. Hypotheses would include improved cross-network integration, reduced maladaptive hyper-synchrony or hypo-connectivity, and increased flexibility between task-positive and resting-state networks. Such changes may reflect enhanced adaptive regulation rather than mere suppression of symptoms.

Importantly, the ECM framework may offer a novel lens for exploring migraine pathophysiology. As migraine is increasingly understood as a disorder of network excitability, sensory gating, and neurovascular-neuroimmune interaction, involving thalamocortical dysrhythmia, cortical spreading depolarization, trigeminovascular activation, hypothalamic modulation, and altered functional connectivity across fronto-parietal and fronto-limbic networks [26], mapping these phenomena onto the ECM allows for a neurodevelopmental understanding of vulnerability patterns.

For example, Circuit 1, associated with early survival imprinting, autonomic regulation, and neuroception, may influence migraine susceptibility through chronic stress exposure, early attachment disruption, or dysregulated hypothalamic-pituitary-adrenal (HPA) axis function. Persistent elevations or maladaptive cycling of cortisol, altered vagal tone, and heightened threat detection may sensitize trigeminovascular pathways and alter pain threshold regulation. Early negative imprint-

ing in Circuit 1 could therefore influence later neurohormonal development and stress reactivity patterns, predisposing individuals to episodic or chronic migraine states.

Circuit 2, associated with emotional conditioning and limbic circuitry, may relate to fronto-limbic dysregulation observed in migraine populations. Altered connectivity between the amygdala, anterior cingulate cortex, insula, and prefrontal regions [34], as well as large-scale cognitive-emotional networks [35], has been implicated in both pain amplification and emotional dysregulation. In this framework, migraine may not solely represent nociceptive dysfunction but a maladaptive emotional-sensory integration state wherein limbic hyper-reactivity and reduced top-down modulation contribute to attack frequency and intensity. NGBB-induced modulation of limbic-prefrontal coherence may therefore reduce both migraine burden and associated affective symptoms.

Circuit 3, linked to cognitive structuring and symbolic processing, may relate to fronto-parietal network instability. Executive dysfunction, sensory hypersensitivity, and altered attentional gating are common in migraine populations. Dysregulation within the fronto-parietal control network and its interaction with the salience network may impair the brain's ability to appropriately filter sensory input, potentially facilitating cortical spreading depolarization events or increasing susceptibility to trigger accumulation.

Circuit 4, associated with socio-sexual development, identity formation, and neuroendocrine maturation, offers another compelling avenue of investigation. Migraine prevalence increases markedly during puberty, particularly among females, implicating estrogen modulation, hypothalamic regulation, and broader neuroendocrine transitions [36]. The pubertal shift may be conceptualized within the ECM as a Circuit 4 developmental reorganization involving hypothalamic-pituitary-gonadal (HPG) axis maturation. Fluctuations in estrogen and progesterone influence cortical excitability, serotonin regulation, CGRP release, and neurovascular tone [37]. Research could therefore explore how NGBB influences hypothalamic connectivity and endocrine rhythmicity, potentially stabilizing migraine patterns associated with hormonal cycling or puberty-related onset.

The higher circuits of the ECM (Circuits 5 - 8), which correspond to expanded sensory processing, cognitive flexibility, and altered states of self-referential awareness, may also offer a framework for understanding migraine vulnerability in certain individuals. Non-ordinary perceptual or dissociative experiences, whether stress-induced, hormonally mediated, or associated with meditation, trauma, or psychoactive exposure, have been linked to alterations in DMN activity, salience network switching, thalamocortical gating, and cortical excitability. If such states occur in the context of insufficient autonomic or limbic stability, they may contribute to network instability, impaired sensory filtering, and heightened susceptibility to cortical spreading depolarization or trigeminovascular activation. From this perspective, migraine may reflect maladaptive oscillation between excessive network rigidity and insufficient regulatory integration across large-scale cortical

and subcortical systems. Future investigation could examine whether neuromodulatory approaches such as NGBB improve hierarchical network coordination and thereby enhance resilience against state-dependent dysregulation.

From a large-scale network perspective, migraine may represent a state of impaired dynamic switching between networks, particularly between the DMN, salience network, and executive networks. If NGBB enhances entropy within rigid oscillatory loops while simultaneously promoting coherent reorganization, it may restore adaptive network flexibility. Such flexibility could reduce the likelihood of pathologic cascade events such as cortical spreading depolarization or maladaptive thalamocortical resonance.

Subsequent research phases would correlate biometric changes with subjective reports, tracking shifts in sensory perception, emotional resilience, interoceptive awareness, and cognitive flexibility. Migraine frequency, duration, intensity, prodromal symptoms, and autonomic correlates (HRV, skin conductance) could be measured longitudinally. A developmental lens would also examine whether early intervention in adolescents at puberty reduces long-term chronification risk.

Long-term studies could assess the persistence of neuroplastic changes, particularly examining the extent to which NGBB induces durable alterations in thalamocortical oscillations, hypothalamic connectivity, and limbic-prefrontal integration. Broaderroader clinical applications could explore NGBB's efficacy in TBI, PTSD, ASD, neurodegenerative diseases, and veterinary neuromodulation. By combining biometric analysis with consciousness research, this interdisciplinary model could position NGBB as a transformative tool in neurotherapeutic interventions.

Notably, anecdotal reports suggest that NGBB has benefited animals, including horses and dogs, raising intriguing possibilities for its application in veterinary medicine and neurological rehabilitation for non-human species.

Finally, an economic and healthcare systems study exploring the long-term impact of integrating NGBB into insurance reimbursement models could be transformative. Assessing its potential to reduce healthcare costs by improving neurological health through noninvasive, preventative care may provide compelling data supporting broader accessibility and policy adoption. By emphasizing early intervention, long-term cost savings, and public health benefits, such research could pave the way for a more integrative and holistic approach to neurological care in mainstream medical systems.

As evidence for neuromodulation continues to accumulate, there is a growing opportunity to integrate protocols such as NGBBMP into mainstream care pathways [26] [31].

4.4.2. Insurance Coverage

Potential reimbursement strategies include classification under noninvasive neuromodulation therapies, chronic pain interventions, preventive neurology services, or digital/technology-assisted therapeutics. Given the substantial economic burden of migraine—estimated at tens of billions of dollars annually in direct and

indirect costs [9]—payers may be receptive to interventions that reduce emergency visits, lost productivity, and polypharmacy while improving functional outcomes.

4.4.3. Clinical Integration

NGBBMP could be deployed across a range of settings, including neurology and headache clinics, primary care practices, integrative and functional medicine centers, pain management programs, military and Veterans Affairs (VA) medical systems, and employer-based wellness or occupational health programs. Training pathways and standardized protocols will be important to ensure quality, safety, and reproducibility across sites [31].

4.4.4. Public Health Perspective

Migraine is the second leading cause of years lived with disability worldwide [9] [27]. Even modest improvements in access to effective neuromodulation could have significant public health implications by reducing disability, enhancing workforce participation, and improving quality of life at the population scale. Implementation studies and health-economic analyses will be critical to guide policy and resource allocation.

4.5. Limitations and Considerations

The data provided by Neurogen Brain Balancing (NGBB) suggest significant improvements across a broad range of neurological and psychological conditions, particularly in populations affected by trauma, PTSD, and brain injuries. The client surveys, clinical observations, and anecdotal reports all reinforce these findings, demonstrating notable symptom reduction and enhanced well-being. Of particular interest is the passive, non-invasive nature of the intervention, which requires no active cognitive engagement from clients. This characteristic makes it uniquely accessible to individuals who may struggle with traditional neurofeedback or talk therapy due to cognitive overload, severe trauma, or attentional impairments. The fact that NGBB is reported to have minimal, if any, side effects further supports its potential as a safe and viable therapeutic option for those seeking an alternative to pharmaceuticals or more invasive interventions. The interplay between chronic pain and psychological stressors is well documented, with research highlighting how prolonged stress can reinforce maladaptive neural pathways that perpetuate both physical and emotional distress [21]. This aligns with findings from Neurogen Brain Balancing, where clients with pain-related conditions often report relief as neurobiomodulation helps restore regulatory balance in the nervous system, reducing both physiological and psychological burdens.

While the findings of this study suggest promising benefits of Neurogen Brain Balancing (NGBB) for neurological and psychological conditions, several limitations and delimitations should be considered when interpreting these findings.

1) The sample size of n = 20 remains relatively small, limiting statistical power

and the generalizability of results. Participants were drawn from a clinical population seeking neuromodulation-based intervention, which may introduce selection bias and limit applicability to broader migraine populations. Larger, multi-site trials are needed to replicate and extend these findings.

2) Because the study lacked a randomized control or sham condition, causal inference is limited, and placebo effects, regression to the mean, and natural symptom variability cannot be fully excluded. That is, without a control group of those who did not experience migraines, it was difficult to determine whether the observed improvements were due to the intervention itself or other external factors, such as placebo effects, expectation biases, or concurrent therapies. The expectation of relief, combined with the therapeutic presence of a caring practitioner, may enhance positive outcomes in some cases. The well-documented role of expectancy in therapeutic interventions suggests that belief in the effectiveness of a treatment can modulate real physiological responses [8]. While placebo responses do not necessarily negate the efficacy of NGBB, they highlight the complex interplay between neurobiological mechanisms, psychological state, and therapeutic context.

Future studies should involve larger, double-blind, placebo-controlled, randomized controlled trials (RCTs) to establish more definitive causal relationships to disentangle the direct neurological impact of NGBB from expectancy-driven improvements, further refining our understanding of its true therapeutic potential. However, due to the fact that each of the five Neurogen sessions that the participants received for their migraines was recorded by the computer, further studies could analyze the quantitative data generated by the sessions and note objective changes in brainwave activity, and thereby correlate them with subjectively reported results.

3) The outcome measures relied on self-report instruments (MIDAS, HIT-6, QOL scales, and goal ratings) completed by participants. While MIDAS, HIT-6, and QOL scales are well validated [27], they remain subject to recall error and expectancy effects. In addition, treatment evaluation is complicated by the well-documented subjective-objective discrepancy observed in clinical settings: practitioner observation and session-based ratings (e.g., SUDS) may indicate measurable improvement even when clients do not perceive meaningful change from session to session. This phenomenon has been attributed to factors such as hedonic adaptation, cognitive biases, emotional variability, and memory distortion [4].

Clients may anchor their perception to their baseline level of distress and fail to recognize incremental gains. Davidson and McEwen (2012) note that gradual neuroplastic changes often unfold over time in ways that are not immediately accessible to conscious awareness [38]. Similarly, exposure-based treatments for PTSD and anxiety show that clients may report feeling unchanged even as SUDS scores decline across sessions, reflecting physiological and psychological improvement [6]. These considerations underscore the value of consistent symptom tracking and clinician validation to support accurate appraisal of change and sustained engage-

ment in treatment.

Future studies would be strengthened by incorporating objective biomarkers and digital headache diaries.

4) The study was not designed to directly measure neurophysiologic mechanisms. Although mechanistic interpretations are supported by existing literature, no EEG, imaging, or biomarker measures were collected to confirm changes in cortical excitability, thalamocortical rhythms, neuroinflammatory signaling, or autonomic regulation.

5) While improvements were large and rapid, the intervention window was relatively short—five 30-minute sessions over four weeks—so the durability of treatment effects, optimal dosing schedules, and longer-term safety beyond the immediate post-treatment period remains to be established. These limitations underscore the need for larger, randomized, controlled trials with longer follow-up periods, objective digital headache diaries, and, where feasible, neurophysiologic or imaging biomarkers to better characterize mechanisms and durability [30] [31].

6) The sample consisted largely of high chronicity individuals with longstanding, treatment-experienced migraine histories ≥ 10 years who were motivated to try a novel therapy. Exploratory analyses suggest that the longest-duration sufferers may require more prolonged or intensive neuromodulation protocols. Conversely, results may differ in less chronic or less treatment-experienced populations.

7) All sessions were delivered by seven certified practitioners, raising the possibility of therapist or site effects that were not explicitly modeled.

8) Finally, although adverse effects were minimal and NGBBMP was well tolerated, the study was not powered to detect rare adverse events.

Overall, these findings suggest that Neurogen Brain Balancing may offer a promising and innovative approach for managing neurological and psychological conditions, particularly in trauma-affected populations. The evidence supports its potential role in facilitating neuroplasticity, improving emotional regulation, and enhancing cognitive function. However, future research should include randomized controlled trials with larger and more diverse samples, objective neurophysiologic endpoints, longer follow-up intervals, and rigorous safety monitoring to optimize treatment protocols and evaluate their applicability across broader clinical populations.

Despite these limitations, the present findings provide preliminary evidence supporting the feasibility, tolerability, and potential clinical benefit of NGBBMP for individuals with chronic migraine, and the convergence of evidence across multiple validated instruments, the magnitude of effect sizes, and the rapid onset of benefit in a highly chronic, heavily pre-treated cohort suggest that the Neurogen Brain Balancing Migraine Protocol represents a promising neuromodulation approach that warrants evaluation in larger controlled trials.

5. Conclusions

This feasibility study suggests that the Neurogen Brain Balancing Migraine Protocol (NGBBMP) is a promising noninvasive neuromodulation approach capable

of producing rapid, clinically meaningful, and multidimensional improvements in individuals with chronic migraine. Benefits were observed across all major validated domains—pain severity, functional disability, quality of life, and patient-defined goals—and were achieved with minimal burden, minor-to-no reported adverse effects, and no additional pharmacologic exposure.

In a therapeutic landscape where many patients feel overmedicated, underserved, or simply unseen, neuromodulation offers a gentle yet powerful alternative. By working directly with the brain's intrinsic capacity for regulation and plasticity, NGBBMP aligns with a more humanistic, systems-oriented view of migraine—one that sees the condition as modifiable rather than fixed, and the person as an active participant in their own healing [26] [28] [31].

Neurogen Brain Balancing offers a unique modality of neurobiomodulation that provides practitioners and patients with a safe and reliable, non-invasive, painless, non-pharmacological solution for a variety of common mental health challenges. The reported successes of Neurogen provide measurable improvements across a broad category of conditions, positioning it as a valuable tool in modern healthcare. Several points are noteworthy: 1) the lack of any major adverse effects noted after the administration of thousands of Neurogen sessions, 2) the high rate of positive benefits reported subjectively, and 3) quantitatively measurable improvements as reported subjectively by participants and observed by practitioners.

The combination of safety, scalability, affordability, and meaningful outcomes positions Neurogen as a valuable adjunct to existing migraine care and a compelling candidate for adaptation to other neurologic and stress-related conditions. Future controlled trials, mechanistic studies, and implementation research across diverse clinical settings will be essential to fully integrate NGBBMP into mainstream clinical practice and to realize its potential impact on the global burden of migraine [9] [27].

Declaration

This study represents an independent feasibility evaluation of the Neurogen Brain Balancing Migraine Protocol. The neuromodulation sessions delivered in this project are noninvasive wellness interventions and are not intended to diagnose, treat, cure, or prevent any medical condition. Findings should be interpreted within the limitations inherent to feasibility research, including the uncontrolled design and reliance on participant-reported outcomes.

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Conflicts of Interest

The authors declare no conflicts of interest related to Neurogen Brain Balancing, the Neurogen Brain Balancing Migraine Protocol (NGBBMP), or the organizations involved in this project. No author holds a financial interest in NGBB. The authors declare that the parties had no role in data analysis, interpretation, or writing of this manuscript. All findings, including positive, neutral, or negative results, have been transparently reported.

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Appendix A: Initial E-Mail Invitation and Accompanying Graphic to Invite Participants in the Migraine Study

Breakthrough EEG Neuromodulation Therapy Research

Are migraines disrupting your life? You are invited to take part in a clinical research study evaluating EEG-based neuromodulation therapy, a gentle, non-invasive, drug-free method designed to help restore healthy brainwave patterns and support migraine relief.

What the study provides:

1) Five complementary neurofeedback sessions, each lasting approximately 30 minutes.

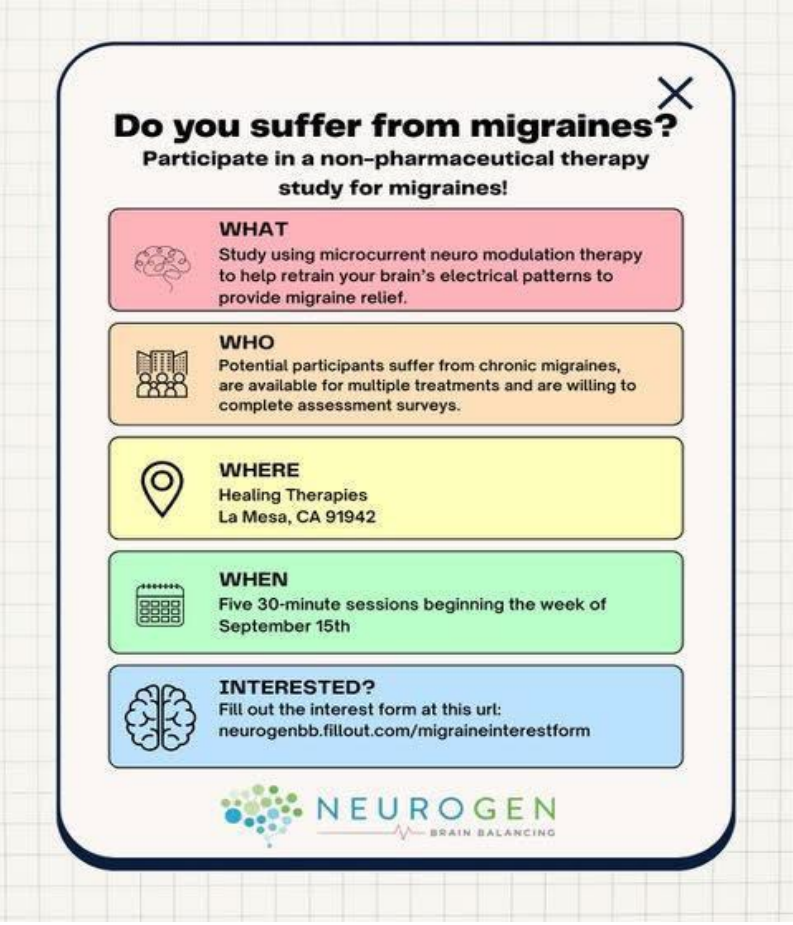
2) A fully drug-free intervention protocol.

3) A personalized neuromodulation approach based on your individual needs.

4) An opportunity to contribute to emerging research that may improve care for millions of migraine sufferers.

5) Continuous professional monitoring throughout the study period.

6) This therapy is non-invasive, passive, does not involve pain, and carries no potential for harm.



Study details:

1) Location: San Diego and additional participating locations.

Session schedule:

1) Two sessions during the week of September 15th.

2) Two sessions during the week of September 22nd.

3) One session during the week of September 29th.

4) Total time commitment: approximately 2.5 hours over one month.

Eligibility requirements:

1) Adults aged 18 years or older who experience regular migraines.

2) Willingness to complete the intake and exit surveys.

3) Ability to commit to all five neuromodulation sessions.

Next steps:

1) Express your interest to your local Neurogen Brain Balancing practitioner.

2) Complete the interest form at: neurogeNGBB.fillout.com/migraineinterestform.

3) Await follow-up screening from the research team.

Appendix B: Migraine Study Interest Form

Thank you for your interest in Neurogen Brain Balancing!

We are conducting a research study evaluating the effectiveness of neuromodulation therapy for migraine relief. The study includes five complimentary 30-minute brain balancing sessions using EEG-guided technology designed to help regulate disrupted neural pathways.

Study visits will be held at Healing Therapies in La Mesa, CA, beginning the week of September 8.

If you are interested in participating, please complete the brief form below. We will review your information and follow up with additional details.

Please note: Submitting this form does not guarantee enrollment. All participants must meet the eligibility requirements and complete an informed consent process prior to participation.

To learn more about Neurogen Brain Balancing or to view frequently asked questions, please visit: neurogenbb.com.

If you have questions, you are welcome to contact us at: (email address redacted).

Form Fields:

1) Name

2) Primary Email

3) Phone Number

4) Country

(Dropdown list)

How long have you been experiencing migraines?

1) 1 - 6 months

2) 6 - 12 months

3) 2 - 3 years

4) More than 3 years

Please briefly describe the symptoms you typically experience during a migraine attack:

(Short answer response)

Is there anything else you would like us to know?

(Optional comment box)

Appendix C: Neurogen Brain Balancing Neuromodulation Research Study Intake Questionnaire

First Name: _____

Last Name: _____

Email: _____

Date: _____

1. Migraine History

How long have you been experiencing migraines?

(Select one: less than 1 year/1 - 5 years/6 - 10 years/more than 10 years/other)

Other (if applicable): _____

How many migraine days do you typically experience per month?

(5 - 9 days/10 - 14 days/15 - 19 days/more than 20 days): _____

What is the typical duration of your migraines?

(less than 4 hours/4 - 12 hours/12 - 24 hours/1 - 2 days/more than 2 days): _____

Average migraine pain scale (1 - 10): _____

2. Migraine Triggers

Check all that apply:

1) Stress or anxiety
2) Hormonal changes
3) Weather changes
4) Certain foods
5) Lack of sleep
6) Bright lights
7) Loud sounds
8) Strong odors
9) Skipping meals
10) Alcohol
11) Caffeine
12) Physical exertion

3. Migraine Symptoms

Check all that apply:

1) Throbbing or pulsating pain
2) Nausea
3) Vomiting
4) Light sensitivity
5) Sound sensitivity
   a) Visual aura
   b) Dizziness
   c) Neck pain or stiffness
   d) Fatigue
   e) Difficulty concentrating

How many migraine medications are you currently taking?

_____

List all migraine medications you are taking:

_____

_____

List non-medication treatments you have tried:

(Examples include preventive medications, acute medications, massage therapy, nerve blocks, CBT, acupuncture, chiropractic care, neuromodulation devices, ear piercings, hot or cold therapy, magnesium IV, cranial facial massage, biofeedback, physical therapy, plant-based diet, ibuprofen injection, neurostimulation implants, or others.)

What has been the most effective treatment?

4. MIDAS Assessment (Last 3 Months)

Days missed from work or school due to headaches: _____

Days when productivity at work or school was reduced by half or more

(do not include days already missed): _____

Days household work was not done due to headaches: _____

Days household productivity was reduced by half or more

(do not include days already counted): _____

Days missed from family, social, or leisure activities: _____

5. HIT-6 Assessment (Last 4 Weeks)

Select one for each item: never/rarely/sometimes/very often/always

When headaches occur, how often is the pain severe? _____

How often do headaches limit your usual daily activities? _____

How often do you wish you could lie down during a headache? _____

How often have you felt too tired to work or perform daily tasks? _____

How often have you felt fed up or irritated because of headaches? _____

How often have headaches limited your ability to concentrate? _____

6. Impact on Daily Life

How much do migraines interfere with your sleep?

(not at all/slightly/moderately/quite a bit/extremely): _____

How much do migraines interfere with your work or school? _____

How much do they interfere with your relationships? _____

How much do they interfere with your recreation? _____

How much do they interfere with your mood? _____

Quality of life rating (1 = excellent, 5 = poor): _____

7. Demographic Information

Gender: _____

Age: _____

City: _____

Name of practitioner you are working with: _____

Email of practitioner: _____

8. Treatment Expectations

Rate each item from 1 (not important) to 5 (extremely important):

Reduce migraine frequency: _____

Reduce migraine intensity: _____

Reduce migraine duration: _____

Improve daily functioning: _____

Reduce medication dependence: _____

Improve sleep quality: _____

The primary goals for participating in this study are:

Optimism that this treatment will help migraines (1 -10): _____

Questions or concerns about the study:

9. Consent and Agreement

I understand that this is a research study and that participation is voluntary.

I agree to complete this intake questionnaire, participate in five Brain Balancing Sessions in Fall 2025, and complete an exit survey. Optional follow-up surveys may be offered at 6 weeks and 6 months.

By signing below, I acknowledge that I have been informed about the study procedures and consent to participate.

Electronic signature (type name): _____

Date: _____

Parent or guardian signature (if applicable): _____

Date: _____

Emergency contact name: _____

Emergency contact phone number: _____

Country of residence: _____

Appendix D: Neurogen Brain Balancing Neuromodulation Research Study—Exit Questionnaire (Verbatim Items)

First Name

Last Name

Email

Date Started

Date Completed

Sessions Completed

1

2

3

4

5

1. Part A: MIDAS (Migraine Disability Assessment Scale)—Post-Treatment

Instructions: Please answer the following questions about ALL headaches you have had over the LAST 3 WEEKS (since starting treatment). Write zero if you did not do the activity.

On how many days in the last 3 weeks did you miss work or school because of your headaches?

How many days in the last 3 weeks has your productivity at work or school reduced by half or more because of your headaches?

On how many days in the last 3 weeks did you not do household work because of your headaches?

How many days in the last 3 weeks has your productivity in household work been reduced by half or more because of your headaches?

On how many days in the last 3 weeks did you miss family, social, or leisure activities because of your headaches?

2. Part B: HIT-6 (Headache Impact Test)

Instructions: Please check the box that best describes how often you have experienced each situation due to headaches over the LAST 3 weeks/since your first Brain Balancing session.

When you have headaches, how often is the pain severe?

Never/Rarely/Sometimes/Very Often/Always.

How often do headaches limit your ability to do usual daily activities?

Never/Rarely/Sometimes/Very Often/Always.

When you have a headache, how often do you wish you could lie down?

Never/Rarely/Sometimes/Very Often/Always.

In the past 3 weeks, how often have you felt too tired to do work or daily activities because of your headaches?

Never/Rarely/Sometimes/Very Often/Always.

In the past 3 weeks, how often have you felt fed up or irritated because of your headaches?

Never/Rarely/Sometimes/Very Often/Always.

In the past 3 weeks, how often did headaches limit your ability to concentrate on work or daily activities?

Never/Rarely/Sometimes/Very Often/Always.

3. Part C: Additional Clinical Information—Post-Treatment

On how many days in the last 3 weeks did you have a migraine or headache?

On a scale of 1 - 10, what was the average pain rating for your headaches over the last 3 weeks?

(1 = No Pain/10 = Severe Pain)

Compared to before your Brain Balancing treatment, how would you rate the change in your migraine frequency?

1 = Much better

2 = Somewhat better

3 = No change

4 = Somewhat worse

5 = Much worse

Compared to before your Brain Balancing treatment, how would you rate the change in your migraine intensity?

1 = Much better

2 = Somewhat better

3 = No change

4 = Somewhat worse

5 = Much worse

Share any comments here: _____

4. Part D: Quality of Life Impact—Post-Treatment

How much have migraines interfered with your sleep since the first Brain Balancing session?

Not at all/Slightly/Moderately/Quite a bit/Extremely.

How much have migraines interfered with your work/school since the first Brain Balancing session?

Not at all/Slightly/Moderately/Quite a bit/Extremely.

How much have migraines interfered since the first Brain Balancing session with your relationships?

Not at all/Slightly/Moderately/Quite a bit/Extremely.

How much have migraines interfered since the first Brain Balancing session with your recreation?

Not at all/Slightly/Moderately/Quite a bit/Extremely.

How much have migraines interfered with your mood since the first Brain Balancing session?

Not at all/Slightly/Moderately/Quite a bit/Extremely.

Rate your overall quality of life since you started this study:

1 = Excellent

2 = Very good

3 = Good

4 = Fair

5 = Poor

Compared to what you would have typically expected over the same period of time since your Brain Balancing sessions started, how would you rate your difference?

1 = Excellent

2 = Very good

3 = Good

4 = Fair

5 = Poor

5. Part E: Treatment Experience and Satisfaction

Overall, how satisfied are you with the Neurogen Brain Balancing treatment?

1 = Very satisfied

2 = Satisfied

3 = Neutral

4 = Dissatisfied

5 = Very dissatisfied

How likely are you to recommend this treatment to others with migraines?

0 - 2 = Not at all likely

3 - 4 = Somewhat likely

5 - 6 = Moderately likely

7 - 8 = Likely

9 - 10 = Very likely

Did you experience any side effects or adverse reactions during treatment?

1 = No side effects

2 = Mild side effects

3 = Moderate side effects

4 = Severe side effects

If your score was 2 or less, please describe: _____

Rate how well each treatment goal was achieved (1 = Not achieved, 5 = Completely achieved):

Reduced migraine frequency

Reduced migraine intensity

Reduced migraine duration

Improved daily functioning

Reduced medication dependence

Improved sleep quality

Overall treatment effectiveness rating (0 = No improvement, 10 = Complete resolution):

0 - 10 scale

Please share any noteworthy feedback regarding your Neurogen Brain Balancing experience that is not addressed in the above survey.

Sleep/Energy/Focus/Task Accomplishment/Impact on Medication/Others that might be valuable to others considering this approach.

6. Consent & Signature

My participation in this research study was voluntary. My scores represent my own findings at the time of the survey.

Are you open to completing follow-up surveys at 90 days and another 90 days to measure the sustainability of Brain Balancing results?

Yes/No

Are you open to sharing a photo of yourself that could be used as part of the final report?

Yes/No

Are you open to creating and sharing a ~60-second video describing the benefits of your Neurogen Brain Balancing experience?

Yes/No

Participant Electronic Signature (type your name): _____

Date: _____

Parent Electronic Signature (if applicable): _____

Date: _____

Appendix E

Follow-Up Questionnaire

Neurogen Brain Balancing Neuromodulation Research Study

Post-90-Day Exit Questionnaire

Instructions:

Answer this survey using your first Neurogen Brain Balancing session as the starting point, up until the day you complete this survey.

Participant Information

First Name: _____

Last Name: _____

General Feedback

In general, did the Neurogen Brain Balancing sessions help you with your migraines as compared to before your first session?

☐ Agree

☐ Disagree

Since your first Neurogen Brain Balancing session, would you say your migraines are (frequency):

☐ Less Frequent

☐ More Frequent

☐ About the same

Since your first Neurogen Brain Balancing session, would you say your migraines are (intense):

☐ Less Intense

☐ More Intense

☐ About the same

Since your first Neurogen Brain Balancing session, would you say your migraines are (painful):

☐ Less Painful

☐ More Painful

☐ About the same

Since your first Neurogen Brain Balancing session, would you say migraines have impacted your work/school/life:

☐ Less Impact

☐ More Impact

☐ About the same

Comparing before your first Neurogen Brain Balancing session with the ~90 days since your first session, would you say your SLEEP is:

☐ Worse

☐ Better

☐ About the Same

Part A. MIDAS (Migraine Disability Assessment Scale)-Post Treatment

Instructions:

Please answer the following questions about ALL headaches you have had over the LAST 90 days (since your first Neurogen Brain Balancing session). Write zero if you did not do the activity.

On how many days in the since your first Neurogren Brain Balancing session did you miss work or school because of your headaches?

On how many days in the since your first Neurogren Brain Balancing session was your productivity at work or school reduced by half or more because of your headaches?

On how many days in the since your first Neurogren Brain Balancing session did you not do household work because of your headaches?

On how many days in the since your first Neurogren Brain Balancing session was your productivity in household work reduced by half or more because of your headaches?

On how many days in the since your first Neurogren Brain Balancing session did you miss family, social or leisure activities because of your headaches?

Part B. HIT-6 (Headache Impact Test) Questions (Since Your First Session)

Instructions:

Please check the box that best describes how often you experience each situation due to headaches since your first Brain Balancing session.

When you have headaches, how often is the pain severe?

☐ Never

☐ Rarely

☐ Sometimes

☐ Very Often

☐ Always

How often do headaches limit your ability to do usual daily activities?

☐ Never
☐ Rarely
☐ Sometimes
☐ Very Often
☐ Always

When you have a headache, how often do you wish you could lie down?

☐ Never
☐ Rarely
☐ Sometimes
☐ Very Often
☐ Always

In the past 3 weeks, how often have you felt too tired to do work or daily activities because of your headaches?

☐ Never
☐ Rarely
☐ Sometimes
☐ Very Often
☐ Always

In the past 3 weeks, how often have you felt fed up or irritated because of your headaches?

☐ Never
☐ Rarely
☐ Sometimes
☐ Very Often
☐ Always

In the past 3 weeks, how often did headaches limit your ability to concentrate on work or daily activities?

☐ Never
☐ Rarely
☐ Sometimes
☐ Very Often
☐ Always

Part C. Additional Clinical Information

90-Days Post 1st Treatment

On how many days in the last 3 weeks did you have a migraine/headache?

Number of days: _____

On a scale of 1 - 10, what was the average pain rating for your headaches over the last 3 weeks?

(1 = No Pain/10 = Severe Pain)

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10

Compared to before your Brain Balancing treatment, how would you rate the change in your migraine frequency?

☐ 1 = Much better
☐ 2 = Somewhat better
☐ 3 = No change
☐ 4 = Somewhat worse

☐ 5 = Much worse

Compared to before your Brain Balancing treatment, how would you rate the change in your migraine intensity?

☐ 1 = Much better

☐ 2 = Somewhat better

☐ 3 = No change

☐ 4 = Somewhat worse

☐ 5 = Much worse

Please share any comments here:

Part D. Quality of Life Impact

90-Days Post 1st Treatment

How much have migraines interfered since the first Brain Balancing session with your sleep?

☐ Not at all ☐ Slightly ☐ Moderately ☐ Quite a bit ☐ Extremely

How much have migraines interfered since the first Brain Balancing session with your work/school?

☐ Not at all ☐ Slightly ☐ Moderately ☐ Quite a bit ☐ Extremely

How much have migraines interfered since the first Brain Balancing session with your relationships?

☐ Not at all ☐ Slightly ☐ Moderately ☐ Quite a bit ☐ Extremely

How much have migraines interfered since the first Brain Balancing session with your recreation?

☐ Not at all ☐ Slightly ☐ Moderately ☐ Quite a bit ☐ Extremely

How much have migraines interfered since the first Brain Balancing session with your mood?

☐ Not at all ☐ Slightly ☐ Moderately ☐ Quite a bit ☐ Extremely

Rate your overall quality of life since you started this study:

☐ 1 = Excellent

☐ 2 = Very good

☐ 3 = Good

☐ 4 = Fair

☐ 5 = Poor

Compared to what you would have typically expected over the same period of time since your Brain Balancing sessions started, how would you rate your difference?

☐ 1 = Excellent

☐ 2 = Very good

☐ 3 = Good

☐ 4 = Fair

☐ 5 = Poor

Part E. Treatment Experience and Satisfaction

90-Days Post First Session

Overall, how satisfied are you with the Neurogen Brain Balancing treatments?

☐ 1 = Very satisfied

☐ 2 = Satisfied

☐ 3 = Neutral

☐ 4 = Dissatisfied

☐ 5 = Very dissatisfied

How likely are you to recommend this treatment to others with migraines?

☐ 0 - 2 = Not at all likely

☐ 3 - 4 = Somewhat likely

☐ 5 - 6 = Moderately likely

☐ 7 - 8 = Likely

☐ 9 - 10 = Very likely

Did you experience any side effects or adverse reactions during treatment?

☐ 1 = No side effects

☐ 2 = Mild side effects

☐ 3 = Moderate side effects

☐ 4 = Severe side effects

Rate how well each treatment goal was achieved

(1 = Not achieved, 5 = Completely achieved)

Reduced migraine frequency: ☐1 ☐2 ☐3 ☐4 ☐5

Reduced migraine intensity: ☐1 ☐2 ☐3 ☐4 ☐5

Reduced migraine duration: ☐1 ☐2 ☐3 ☐4 ☐5

Improved daily functioning: ☐1 ☐2 ☐3 ☐4 ☐5

Reduced medication dependence: ☐1 ☐2 ☐3 ☐4 ☐5

Improved sleep quality: ☐1 ☐2 ☐3 ☐4 ☐5

Overall treatment effectiveness rating:

(0 = No improvement, 10 = Complete resolution)

☐0 ☐1 ☐2 ☐3 ☐4 ☐5 ☐6 ☐7 ☐8 ☐9 ☐10

Have you made any changes to your medication protocol as a result of your Neurogen Brain Balancing treatments?

☐ Yes

☐ No

Please share any noteworthy feedback with respect to your Neurogen Brain Balancing experience that is not addressed in the above survey.

Sleep/Energy/Focus/Task Accomplishment/Impact on Medication/Others that might be valuable to others considering this approach to addressing their own migraine issues.

Please share your comments regarding your Neurogen Brain Balancing experience that may be useful to others considering this modality: