American Journal of Medicine and Medical Sciences 2025, 15(9): 2886-2887
DOI: 10.5923/j.ajmms.20251509.08

Comparative Analysis of the Effectiveness of Transcranial Magnetic Stimulation with Different Frequencies in Modulating the Recovery Process in Facial Nerve Neuropathy

Kuliyev Husniddin Shamseyivich[1,*], Shamsiyeva Muattar Akhmatovna[2]

[1]Researcher, Department of "Neurology", Bukhara State Medical Institute named after Abu Ali ibn Sino, Bukhara, Uzbekistan
[2]Assistant, Department of "Infectious Diseases and Infectious Diseases of Children", Bukhara State Medical Institute named after Abu Ali ibn Sino, Bukhara, Uzbekistan

Abstract Facial nerve neuropathy can significantly affect quality of life, often requiring extended rehabilitation. Transcranial Magnetic Stimulation (TMS), a non-invasive neuromodulation technique, has emerged as a potential adjunctive therapy. This study aims to compare the therapeutic outcomes of different TMS frequencies in modulating the recovery of facial nerve function. A systematic analysis of low-frequency (≤1 Hz) and high-frequency (≥5 Hz) repetitive TMS (rTMS) was conducted in clinical and preclinical contexts. The findings suggest frequency-dependent effects on cortical excitability and neural plasticity, with high-frequency TMS showing greater improvements in motor recovery. However, optimal protocols remain to be standardized. Further large-scale trials are recommended.

Keywords Transcranial Magnetic Stimulation, Facial Nerve Neuropathy, Frequency, Neuromodulation, Motor Recovery, Neurorehabilitation

1. Introduction

Facial nerve neuropathy, particularly resulting from Bell's palsy or traumatic injury, leads to partial or complete loss of facial motor function. Traditional therapeutic approaches include corticosteroids, physical therapy, and surgical interventions. Recently, non-invasive brain stimulation techniques like Transcranial Magnetic Stimulation (TMS) have gained attention for their neurorehabilitative potential [1,2,3,4,5].

TMS is capable of altering cortical excitability through electromagnetic induction. Depending on the frequency used, TMS can either inhibit or facilitate neuronal activity, offering a tailored approach to neuroplastic modulation. This paper presents a comparative analysis of low- versus high-frequency TMS in improving facial nerve recovery [6,7].

2. Materials and Methods

This comparative clinical study was conducted at the Bukhara Regional Hospital between January 2024 and March 2025. A total of 120 patients, aged between 20 and 65 years, diagnosed with unilateral facial nerve neuropathy of either idiopathic (Bell's palsy) or traumatic origin, were enrolled. Diagnosis was confirmed through clinical neurological examination and surface electromyography (sEMG). Patients were included if their symptoms had developed within the previous three months and if they had no contraindications for transcranial magnetic stimulation (TMS), such as epilepsy, metal implants, or pregnancy [8].

The patients were randomly divided into two equal groups of 60 individuals each. Group A received low-frequency repetitive TMS (1 Hz), while Group B received high-frequency stimulation (10 Hz). TMS was administered using a Magstim Rapid2 stimulator equipped with a figure-of-eight coil, which was positioned over the primary motor cortex contralateral to the affected side of the face. In the low-frequency group, patients received 600 pulses per session at 90% of their resting motor threshold (RMT), delivered once daily over a 10-day period. The high-frequency group received 1500 pulses per session, also at 90% RMT, delivered in 10-second trains with inter-train intervals of 60 seconds, also for 10 consecutive days.

Statistical analysis was performed using SPSS version 26.0. Independent t-tests and chi-square tests were used for baseline comparisons between groups, and repeated measures ANOVA was applied to evaluate changes in clinical outcomes over time. Statistical significance was set at $p < 0.05$.

* Corresponding author:
husniddinquliyev3@gmail.com (Kuliyev Husniddin Shamseyivich)
Received: Jun. 27, 2025; Accepted: Jul. 23, 2025; Published: Sep. 3, 2025
Published online at http://journal.sapub.org/ajmms

3. Results

A total of 120 patients completed the study without any significant dropouts or adverse effects related to transcranial magnetic stimulation (TMS). The demographic characteristics of the participants, including age, gender distribution, and etiology of facial nerve neuropathy, were comparable between the two groups, with no statistically significant differences observed at baseline ($p > 0.05$).

Clinical assessment using the House-Brackmann Facial Grading Scale (HBFGS) showed significant improvement in both groups after the 10-day TMS intervention. However, the high-frequency group (10 Hz) demonstrated a greater degree of recovery. At baseline, both groups had a similar mean HBFGS score (Group A: 4.2 ± 0.5; Group B: 4.1 ± 0.6). After treatment, the mean score in the high-frequency group improved to 2.3 ± 0.4, compared to 3.1 ± 0.5 in the low-frequency group ($p < 0.01$). At the one-month follow-up, this difference remained significant (Group A: 2.8 ± 0.4; Group B: 1.9 ± 0.3; $p < 0.001$).

Electromyographic (sEMG) recordings revealed increased facial muscle activity in both groups post-intervention. In the high-frequency group, the average amplitude of motor unit potentials increased by 65%, while the low-frequency group showed a 38% increase. This difference was statistically significant ($p < 0.01$). Similarly, motor evoked potential (MEP) latency decreased more prominently in the high-frequency group, indicating enhanced neural conduction.

Quality of life, as measured by the Facial Disability Index (FDI), also improved significantly in both groups. The high-frequency group reported a greater increase in both physical and social subscale scores ($p < 0.05$). Patients in Group B described better facial symmetry, improved voluntary movement, and reduced synkinesis compared to Group A.

Overall, the high-frequency TMS protocol demonstrated superior efficacy in accelerating functional recovery of the facial nerve, enhancing neurophysiological responses, and improving patient-reported outcomes. No adverse events or complications related to the stimulation procedure were observed in either group throughout the study period.

4. Discussion

The comparative analysis reveals that high-frequency TMS is more effective in accelerating facial nerve recovery due to its facilitatory effect on cortical excitability. However, low-frequency TMS may be beneficial in chronic stages or where excessive excitability leads to poor motor control. Protocol standardization remains a major limitation in current literature, with variations in coil placement, intensity, and duration affecting reproducibility.

The underlying mechanism is thought to involve modulation of corticobulbar projections and brainstem circuits that control facial motor function. Further research is needed to explore individual variability, optimal stimulation parameters, and long-term outcomes.

5. Conclusions

Transcranial Magnetic Stimulation represents a promising adjunct in the rehabilitation of facial nerve neuropathy. Frequency-specific application plays a crucial role, with high-frequency TMS showing superior efficacy in early-stage recovery. Personalized TMS protocols based on the stage and nature of neuropathy could optimize patient outcomes.

REFERENCES

[1] Lefaucheur, J. P., et al. (2014). Evidence-based guidelines on the therapeutic use of repetitive transcranial magnetic stimulation (rTMS). *Clinical Neurophysiology*, 125(11), 2150-2206.

[2] Kim, J., et al. (2020). The effect of high-frequency TMS in facial nerve palsy: A pilot study. *Neurological Research*, 42(5), 383-389.

[3] Rossi, S., et al. (2009). Safety, ethical considerations, and application guidelines for the use of TMS in clinical practice and research. *Clinical Neurophysiology*, 120(12), 2008–2039.

[4] Park, J. Y., Chang, W. H., & Kim, Y. H. (2015). The effect of repetitive transcranial magnetic stimulation on recovery in facial palsy: A preliminary study. *Journal of Rehabilitation Medicine*, 47(3), 260–264. https://doi.org/10.2340/16501977-1927.

[5] Khedr, E. M., El Beh, K. M., &Kotb, H. (2010). Therapeutic trial of repetitive transcranial magnetic stimulation after acute ischemic stroke. *Neurology Research*, 32(7), 712–718. https://doi.org/10.1179/016164110X12644252260429.

[6] Nitsche, M. A., & Paulus, W. (2000). Excitability changes induced in the human motor cortex by weak transcranial direct current stimulation. *The Journal of Physiology*, 527(3), 633–639. https://doi.org/10.1111/j.1469-7793.2000.t01-1-00633.x.

[7] Yang, X., Zhang, Y., Wang, Y., & Jiang, W. (2021). Effects of different frequencies of rTMS on motor function recovery in peripheral nerve injury. *Neural Regeneration Research*, 16(9), 1803–1810. https://doi.org/10.4103/1673-5374.303002.

[8] Dilek, B., & Dilek, A. (2018). The use of repetitive transcranial magnetic stimulation in peripheral facial nerve palsy: A new perspective. *ActaNeurologicaBelgica*, 118(4), 623–627. https://doi.org/10.1007/s13760-018-0988-5.