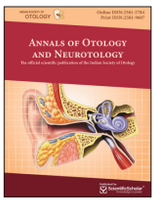
https://aonojournal.com/

Annals of Otology and Neurotology



Original Article

Effectiveness of Neuromodulation Therapy on Tinnitus

Soniya Gupta[1], Prashant Kumar Goyal[1], Kavitha Gurunath Gowda Sannamani[2]

[1]Department of Audiology, Drspectra Wellness Private Limited, Delhi, [2]Department of Audiology, Drspectra Wellness Private Limited, Bengaluru, Karnataka, India

ABSTRACT

Objectives: Tinnitus is the perception of sound without any external source, such as ringing, buzzing, humming, etc. It affects about 15% of the general population. It affects individuals in various ways, such as difficulty to concentrate, irritation, unable to work, lack of sleep, frustration, anger, depression, etc. The hyperactivity of auditory neurons resulted in tinnitus. There are a limited number of treatments for tinnitus. This study was done to know the effectiveness of neuromodulation therapy on tinnitus and associated symptoms and its success rate.

Material and Methods: Forty-six individuals with tinnitus in the age range of 20–80 years were selected tinnitus evaluation was done, and a suitable tinnitus relief device was recommended and therapy was advised, and progress was monitored through follow-up for a year.

Results: The therapy reduced the hyperactivity of auditory neurons, resulting in significant improvement in tinnitus and its associated symptoms.

Conclusion: Hence, it can be concluded that neuromodulation therapy is an effective treatment for tinnitus.

Keywords: Acoustic neuromodulation therapy, Tinnitus relief device, Tinnitus

INTRODUCTION

Tinnitus is defined as the perception of sound without any external sound source. The individual may hear phantom sounds in one ear, in both ears, and in the head. Tinnitus may be heard as ringing, buzzing, humming, pulsatile, high-pitched, low-pitched, soft, or loud. Tinnitus affects about 10–15% of the adult population (Jarach *et al*., 2024).[1] The incidence of tinnitus increases with age. Tinnitus is a symptom rather than a disorder by itself. Any peripheral pathology leading to hair cell damage in the inner ear disrupts the signal reaching the auditory cortex, resulting in neural changes. These changes may happen at the level of synapses between inner hair cells and the auditory nerve and within multiple levels of the central auditory pathway (Henry *et al*., 2014).[2] The cause of tinnitus is commonly linked to hearing loss, medications, ear wax, ear infections, head and neck injuries, exposure to noise, etc (Tsang *et al*., 2024).[3] Because of tinnitus, the individual may find it difficult to concentrate and understand speech, leading to irritation and discomfort (Mohan *et al*., 2022).[4] Tinnitus might be associated with other symptoms such as dizziness or vertigo, irritation due to noise, head heaviness, hearing loss, etc. In severe conditions of tinnitus, the individual may find it difficult to carry out daily routine activities, may affect their career, leading to anxiety and depression (Meijers *et al*., 2022).[5] This calls for early identification and intervention of tinnitus. Currently, various treatments are available, such as cognitive behavioral therapy, sound therapy, hearing aids, maskers, etc. Another novel approach called acoustic neuromodulation has emerged as a potential treatment for tinnitus.

The brain is made up of a huge number of active nerve areas, which all have different roles. Sound information is processed via a very specific brain area known as the auditory cortex. The auditory cortex is divided into areas that are responsible for processing different pitches in a similar way in which keys would be arranged on a piano. Anything which causes us to lose our hearing can have the effect of disrupting the keyboard. This could be caused by medication, loud noises, or just the natural aging process. Due to this disruption, there is a reduction of activity in the keyboard areas affected by

***Corresponding author:** Kavitha Gurunath Gowda Sannamani, Department of Audiology, Drspectra Wellness Private Limited, Bengaluru, Karnataka, India. kavithags521@gmail.com

Received: 21 November 2024 **Accepted:** 13 February 2025 **Published:** 29 April 2025 **DOI:** 10.25259/AONO_6_2024

hearing loss, and the nerves that make up the area can start to fire spontaneously. This is called neuro-synchronization.

Another way is if the ear no longer talks to the auditory center, then the nerve cells in the auditory center begin to chatter in an overactive and unregulated way. It is this abnormal overactivity that causes us to perceive the tinnitus signal. Over time, this abnormal activity becomes permanent. This abnormal neural synchrony does not remain limited to the auditory center; brain areas regulating attention, emotions, and stress are also affected.

There is a dearth of literature on acoustic neuromodulation. Is there a way to reduce and revere the neural synchrony which is related to tinnitus? It is called TinnitusRelief neuromodulation. Hence, our research is carried out to know about (1) TinnitusRelief (TR) neuromodulation therapy, its effect on tinnitus and associated symptoms, and (2) its success rate.

MATERIAL AND METHODS

Forty-Six participants in the age range of 20–80 years were considered for the study as depicted in Figure 1.

Participants were selected with the complaint of tinnitus.

Procedure

Case history was taken where information regarding participants' age, gender, contact number, address, occupation, present complaint and associated symptoms, onset, previous history of any health issues, and earlier investigations was collected. Three questionnaires were administered; namely tinnitus handicap inventory, hyperacusis questionnaire, and dizziness handicap inventory, and scoring was done to find out the severity. Pure tone audiometry was carried out using a classic audiometer to find out the degree and type of hearing loss as shown in Figure 2 and 3. According to the diagnosis, a suitable tinnitus relief device was recommended after a trial of the same. The participant was advised to take therapy at home 3 times, and follow-up was done to monitor the progress. Post-therapy tinnitus handicap inventory, hyperacusis questionnaire, and dizziness handicap inventory were administered to compare the improvement pre- and post-therapy.

TinnitusRelief neuromodulation tones consist of individually measured and specifically calculated acoustic impulses which are transferred into the brain into corresponding electrical stimuli. The acoustic tones are generated by a small matchbox-sized device, the TinnitusRelief device, and administered to the tinnitus patient via medical headphones with a high hearing range of up to 18–20 kHz. This device delivers very low sound, up to 1 dB.

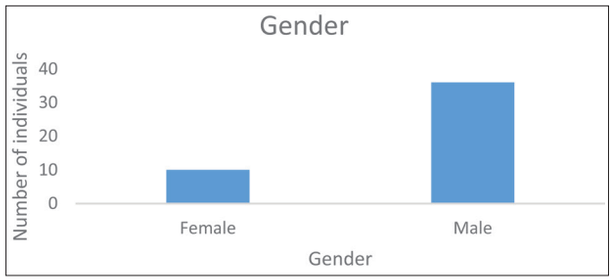


Figure 1: Represents number of males and females in the study.

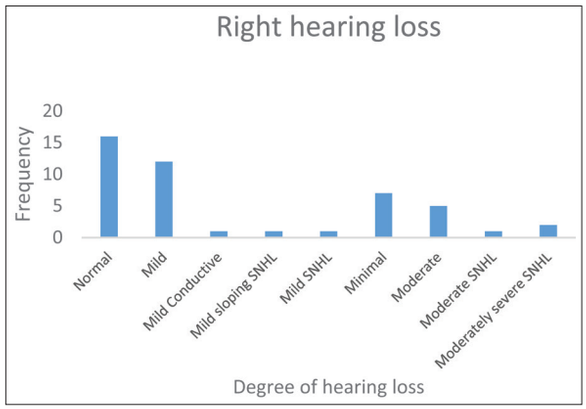


Figure 2: Represents number of degree of hearing loss in right ear. SNHL: Sensoryneural hearing loss.

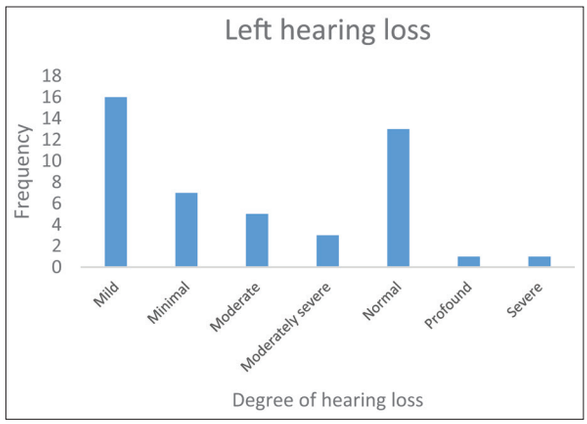


Figure 3: Represents number of degree of hearing loss in left ear.

RESULTS

Statistical Analysis

The descriptive statistics frequencies, percentages, mean, median, and standard deviation were obtained. The data was subjected to the Shapiro-Wilks test for normality to check whether the pre-and post-test scores follow a

normal distribution. The results revealed that the data is significantly deviating from normal distribution ($p < 0.05$). Figure 4 represents mean age and improvement. Therefore, the nonparametric tests Wilcoxon signed rank test was carried out to see the significant difference between pre- and post-test scores as shown in figure 5, 6, and 7. The statistically significant values were compared with the 0.05 or 0.01 level of significance. The whole statistical analysis was done using Statiscal Package for Social Sciences (SPSS).

DISCUSSION

The results of the study reveals significant improvement in tinnitus and other associated conditions like hyperacusis and dizziness after therapy using the Tinnitus Relief device invented by Drspectra Wellness Private Limited. Treatment with TinnitusRelief neuromodulation targets the exact cause of the problem. This innovative treatment is designed to reduce hyperactivity in the specific regions of the brain that are responsible for generating the tinnitus sound. TinnitusRelief neuromodulation uses a complex mathematical algorithm to create a personalized sound perception for each patient. A series of tones created are transmitted to the nerve cells in the brain of the patient in such a way that the cell's abnormal reactivity reduces and hyperactivity is reduced.

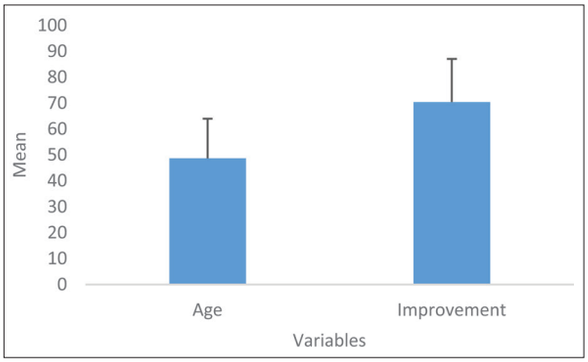


Figure 4: Represents mean age and improvement.

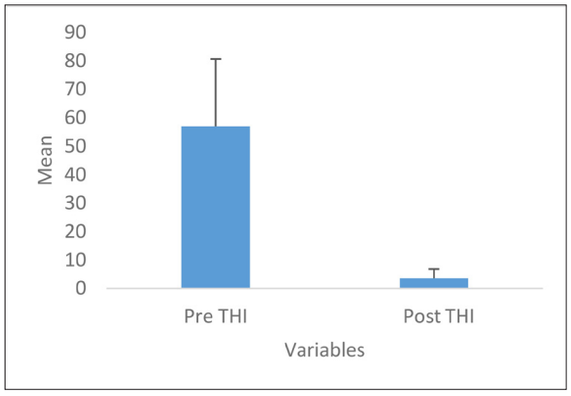


Figure 5: Represents pre- and post-THI mean scores. THI: Tinnitus handicap scores.

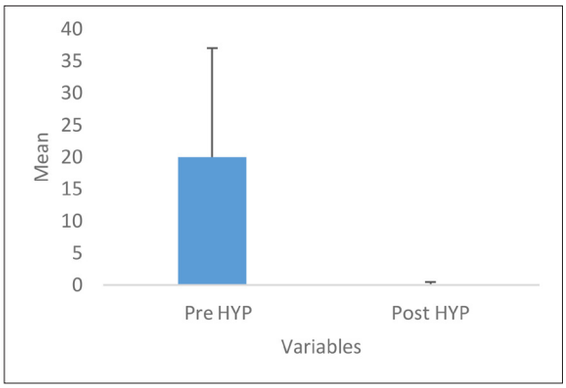


Figure 6: Represents mean pre- and post-hyperacusis scores. HYP: Hyperacusis questionnaire scores.

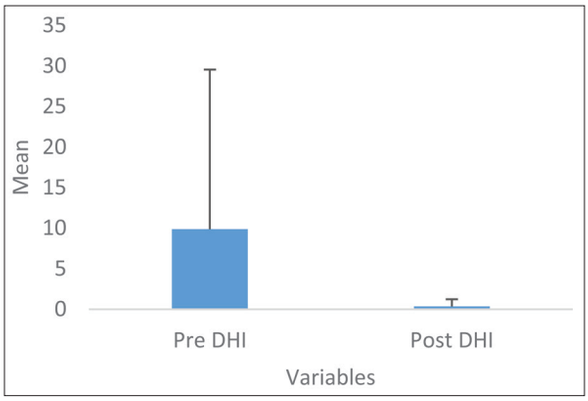


Figure 7: Represents mean pre- and post-DHI scores. DHI: Dizziness handicap scores.

In TinnitusRelief neuromodulation, the synchronous nerve cell network is first stimulated actively from the outside by single tones that are especially and temporarily staggered to force the nerve cells into subgroups, each with its own new rhythm.

Multiple tones are used to deliver this gentle, targeted stimulation to the hearing center of the brain. There are short pauses between the stimulation signals in order to remodel the nerve network. If repeated regularly and often enough, these stimulation signals will reduce the hyperactivity to such an extent that abnormal neural synchrony will permanently be reversed.

Similarly, found that transcranial direct current stimulation based on a noninvasive neuromodulation method found

a reduction in tinnitus loudness (Shekawat *et al*., 2016).[6] Another study on transcranial magnetic stimulation, which is a noninvasive type of neuromodulation where intermittent magnetic fields are produced by a coil that is in contact with the subject's scalp and that delivers electromagnetic pulses and magnetic fields that pass largely undistorted through the cranium and affect the neuronal activity of the brain beneath, resulting in a reduction of chronic tinnitus by Theodoroff *et al*. (2013).[7]

CONCLUSION

The study reveals that acoustic neuromodulation is effective in reducing tinnitus and other associated symptoms. The Tinnitus Relief Device developed by Drspectra has a success rate of more than 90%. Hence, this novel technique is found to be a promising solution to treat tinnitus.

Ethical approval: The research/study complies with the Helsinki Declaration of 1964.
Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent.
Financial support and sponsorship: Nil.
Conflicts of interest: There are no conflicts of interest.
Use of artificial intelligence (AI)-assisted technology for manuscript preparation: The authors confirm that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript and no images were manipulated using AI.

REFERENCES

1. Jarach CM, Lugo A, Scala M, Cederroth CR, Garavello WJD, Schlee W. Epidemiology of Tinnitus: Frequency of the Condition. In: Schlee W, Langguth B, De Ridder D, Vanneste S, Kleinjung T, Møller AR, editors. Textbook of tinnitus. Cham: Springer; 2024.p. 35–47.
2. Henry JA, Roberts LE, Caspary DM, Theodoroff SM, Salvi RJ. Underlying Mechanisms of Tinnitus: Review and Clinical Implications. J Am Acad Audiol 2014;25:5–22.
3. Tsang BKT, Collins GG, Anderson S, Westcott M. Tinnitus Update: What Can Be Done for the Ringing? Intern Med J 2024;54:1066–1076.
4. Mohan A, Leong SL, De Ridder D, Vanneste S. Symptom Dimensions to Address Heterogeneity in Tinnitus. Neurosci Biobehav Rev 2022;134:104542.
5. Meijers SM, Rademaker M, Meijers RL, Stegeman I, Smit AL. Correlation Between Chronic Tinnitus Distress and Symptoms of Depression: A Systematic Review. Front Neurol 2022;13:870433.
6. Shekhawat GS, Sundram F, Bikson M, Truong D, De Ridder D, Stinear CM, *et al*. Intensity, Duration, and Location of High-Definition Transcranial Direct Current Stimulation for Tinnitus Relief. Neurorehabil Neural Repair 2016;30:349–59.
7. Theodoroff SM, Folmer RL. Repetitive Transcranial Magnetic Stimulation as a Treatment for Chronic Tinnitus: A Critical Review. Otol Neurotol 2013;34:199–208.

How to cite this article: Gupta S, Goyal PK, Sannamani KGG. Effectiveness of Neuromodulation Therapy on Tinnitus. Ann Otol Neurotol. 2025;6:e010. doi: 10.25259/AONO_6_2024