Transcranial magnetic stimulation for treatment of tinnitus

Millions of people experience tinnitus – the perception of ringing or other sounds in the ears/head that does not have an external source. The most common cause of tinnitus is damage to/degeneration of auditory structures because of aging, loud sound exposure, or other conditions that contribute to hearing loss. Tinnitus can also be triggered by head/neck injuries and some medications, including high doses of aspirin. In some cases, constant tinnitus interferes with the patient's enjoyment of life and can contribute to insomnia, depression and anxiety. Numerous treatments for tinnitus have been developed and implemented over the last century. These include sound therapy, hearing aids, medications, and cognitive-behavioral therapy (CBT). During the last 10-15 years, transcranial magnetic stimulation (TMS) has been studied as a potential treatment for chronic tinnitus.

TMS is a non-invasive intervention that involves delivering electromagnetic pulses through a coil that is in contact with the patient's scalp. Ultimately, some of this energy is transmitted through the skull and affects the activity of the underlying brain tissue. Repetitive TMS (rTMS) is FDA-approved for treatment of depression. For this application, psychiatrists usually deliver rTMS to the left frontal region of the skull at a rate of 10 pulses per second (10 Hz) for approximately 30 minutes per session. Patients typically attend daily sessions of rTMS for 4-6 weeks.

Because human imaging studies (including those that use functional magnetic resonance imaging) have shown that tinnitus is sometimes associated with abnormal activity in a brain region called auditory cortex, this is often the target for rTMS treatment of tinnitus. In most studies that have been conducted for tinnitus, the TMS coil is positioned just above the patient's ear and pulses are delivered at a rate of one per second (1 Hz). This slower rate of rTMS is thought to suppress neural activity associated with tinnitus generation and perception. For tinnitus, patients usually attend daily sessions of rTMS for 1-4 weeks, although this is still considered an experimental treatment.

Our research group recently published the results of a clinical trial that used 1 Hz rTMS to treat

tinnitus in 64 patients. Half of these patients (32) received 2000 pulses of “active” rTMS daily for 10 consecutive work days. The other half (32 patients) received 2000 pulses of “sham” (or placebo) rTMS daily for 10 consecutive work days. The placebo rTMS coil looks identical to the active coil, and produces sounds and scalp sensations that are similar to the active coil. However, the placebo coil does not generate magnetic fields that penetrate the skull and affect brain activity. The scalp target for rTMS was just above the patient’s ear, on either the left or right side of the head. The primary outcome measure for this study was the Tinnitus Functional Index (TFI), a 25-item questionnaire that assesses the negative impact of tinnitus – a measure of tinnitus severity.

Results of our study indicated that 18 of 32 participants (56%) in the active rTMS group and 7 of 32 participants (22%) in the placebo rTMS group were “responders” to rTMS treatment, meaning that their TFI score decreased more than 7 points after 10 sessions of rTMS compared to their baseline score. The difference in the percentage of treatment responders between the active and placebo rTMS groups was statistically significant, which provides evidence for the effectiveness of rTMS as a treatment for tinnitus. Furthermore, the improvement in tinnitus severity (TFI score) exhibited by responders to rTMS treatment was sustained throughout the 6-month follow-up period. Although these results are encouraging, larger, multi-site clinical trials should be conducted before rTMS is implemented as a treatment for tinnitus.

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