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TECHNOLOGY AT THE NEURAL INTERFACE
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PART I. INVASIVE PERIPHERAL NERVE STIMULATION

Clinical Science

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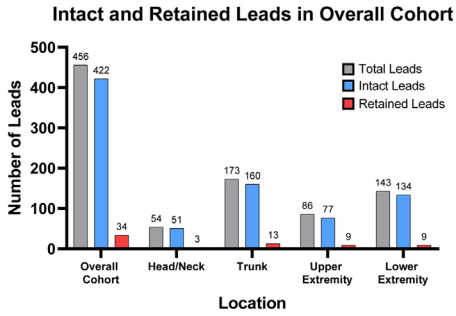
Editor's Choice



We aim to quantify the current incidence of temporary PNS lead fracture/retention and compare this with rates prior to changes in lead hardware design of temporary peripheral nerve stimulators. A multi-center, retrospective observational study was conducted for patients implanted with a temporary PNS system between the dates of June 1, 2018, and August 1, 2024. Patients were included if they underwent temporary percutaneous PNS system implantation with planned lead removal at 60 days. The primary objectives of this study were to (1) quantify the incidence of lead retention with removal of temporary percutaneous PNS, and (2) to compare the rates of lead retention between the original lead design (version 1.0) and the revised lead design (version 2.0). Secondary objectives included analysis of lead retention rates based on the following covariates: body mass index (BMI), patient age, location of lead placement, or duration of lead implant.
337 patients were implanted with a total of 456 leads within the studied timeframe. Of 337 patients, 40.4% (n=136) were implanted with lead version 1.0 and 59.6% (n=201) were implanted with lead version 2.0. Overall, 7.5% (34 of 456) of implanted leads were retained, impacting 10.1% of patients. Of 194 implanted version 1.0 leads, 13.4% (n=26) of leads were retained, whereas of 262 version 2.0 leads, 3.1% (n=8) were retained (p<0.001). These results showed a reduction in retained leads per patient from 19.1% with lead version 1.0 to 4.0% with revised lead version 2.0. Covariates including BMI, patient age, location of lead placement, or duration of lead implant did not predict lead retention rates.

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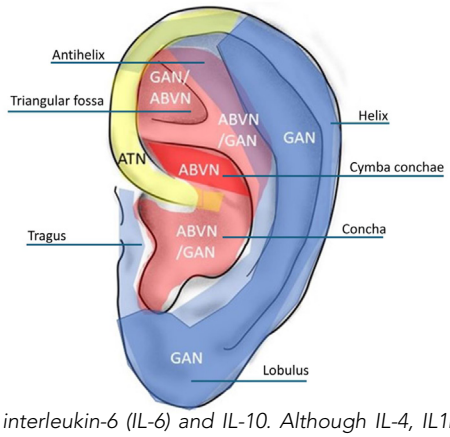

This systematic review evaluated the effects of auricular stimulation (AS) on biomarkers of inflammation and the stress response. MEDLINE (PubMed), EMBASE, Cochrane Central Register of Controlled Trials (CENTRAL), ISI Web of Science, and Scopus Database were searched. Quality and risk assessment of included studies was performed and the meta-analysis of the effect of the most frequently assessed biomarkers was conducted using the statistical software RevMan.

A total of 1122 patients and healthy volunteers of 27 RCTs were included in this systematic review. 81% of the population was female with a median age of 51 years. Pooled data of 18 studies showed a significant effect of AS regarding a reduction of serum C-reactive protein (CRP), tumor necrosis factor-alpha (TNF-alpha), interleukin-6 (IL-6) and IL-10. Although IL-4, IL1beta, cortisol, substance P and calcitonin gene-related peptide, and adrenocorticotropic hormone did not show any changes, salivary amylase increased under AS.

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Basic Science

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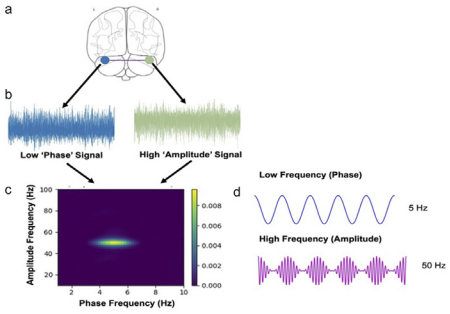

To investigate whether transcutaneous vagus nerve stimulation (tVNS) at different frequencies can affect phase-amplitude coupling between regions of the brain linked to mood and memory disorders, we used simultaneous magnetoencephalography (MEG). Phase-amplitude coupling was measured between areas of the brain in response to different stimulation frequencies of tVNS using concurrent MEG and tVNS in 17 healthy participants. Four stimulation protocols were tested; 24 Hz, 1 Hz and pulse-frequency modulation, all delivered to the cymba concha, and 24 Hz delivered to the ear lobe as a sham. A driven auto-regressive method was used to estimate coupling between brain areas in different physiological frequency bands in response to these protocols.

Different stimulation protocols of tVNS led to alterations in phase-amplitude coupling between multiple brain regions that are linked to mood and memory, notably the prefrontal cortex, hippocampus and the temporal pole. Stimulation delivered at 24 Hz was observed to decrease delta-gamma coupling within the temporal pole and cingulate cortex when contrasted with 24 Hz sham stimulation.

Increased alpha-gamma coupling was observed between the hippocampus and the prefrontal cortex when contrasting 24 Hz with pulse-frequency modulated stimulation. Finally, comparing 24 Hz with low frequency 1 Hz stimulation showed an increase in theta-gamma coupling within the prefrontal cortex.

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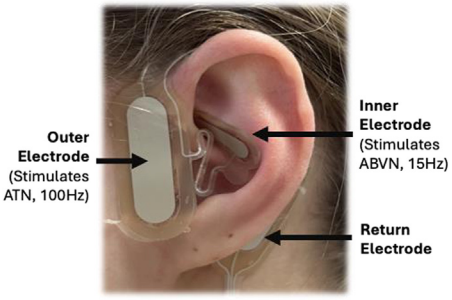

This study evaluates the safety and feasibility of transcutaneous auricular vagus nerve stimulation (taVNS) on the inpatient psychiatric unit and preliminarily explores efficacy for comorbid depression and anxiety. Ten adult patients (5 females, mean age±SD, 35.60±19.14) admitted to the inpatient psychiatric unit with comorbid depression and anxiety participated in this open-label safety and feasibility trial. Patients were randomized to receive one of two taVNS dosing approaches, A) three taVNS sessions on three consecutive days (nine sessions total) (N=5) or B) nine taVNS sessions in one day (N=5). Each day, we assessed depression, using the Patient Health Questionnaire (PHQ-9) and Beck's Depression Inventory (BDI), and anxiety, using the Generalized Anxiety Disorder-7 (GAD-7), and Beck Anxiety Inventory (BAI).

Both taVNS dosing approaches were safe and feasible in this novel setting. Regardless of condition, stimulation significantly reduced GAD-7 (Mean Reduction ± SD, −5.90±6.87, $p<0.05$), BAI (−9.40±10.52, $p<0.05$), PHQ-9 (−6.00±7.57, $p<0.05$) and BDI (−11.00±11.59, $p<0.05$) final scores compared to baseline. There was not a significant difference in clinical response between treatment conditions.

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