

Critical Review:

The efficacy of ultra-high frequency bone conduction stimulation for the treatment of tinnitus

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his critic re ie e ined the iter ture re ting to the effic cy of tr , high frequency one conduction sti tion for the tre t ent of tinnitus he study designs re ie ed inc ded fi e sing e group studies ith pre posttest e peri ent design one of high so inc ded sing e s ect c se study one nonr ndo ized c inic tri cohort study nd t o prospecti e cross oer e peri ent studies ith sing e s ect design O er the e idence did not s pport the use of one conducted tr , high frequency tre t ent for tinnitus nd ch nge in c rrent c inic pr ctice is not reco ended Gi en the i ited n er of e , designed studies pro iding high e e of e idence further rese rch sho d e co p eted Future studies sho d inc de p tients ith r io s types of tinnitus nd use rger s p e sizes prospecti e ithin group cross oer designs do e inding nd p ce os t o d so e e nefici to co p re tre t ent res ts for sti i of different frequency r nges nd to co p re sti i de i er ed i one conduction to sti i de i er ed i ir conduction to deter ine hether one conducted sti i is in f ct ore e nefici th n r tition tinnitus s ing e methods

Introduction

tinnitus is pro e f ced yo er i ion peop e in the nited St tes nd se ere c ses h e een reported y ppro i te y i ion nt nd Sper ing , p , tinnitus is sy pto ch r ctized y sens tions in the he d or e rs in the sence of e tern sti i nd y inc de ringing jzzing or other noises tinnitus Association of C n d So e s offerers report irritation difficulty , concentr ting difficulty s eeping depression nd fee ings of desp ir Er ndsson p Gi en the pre ence nd effects of tinnitus it is i port nt to e a te tre t ent options to deter ine hether there is e idence to s pport the i p e ent tion of ne ther pies in c inic pr ctice

here re t o in c tegories of tinnitus o ecti e nd s ecti e O ecti e tinnitus is physic so nd th t origin tes intern y nd c n e detected y physi n n contr st s ecti e tinnitus is adi e on y to the p tient s offering fro the disorder nt nd Sper ing , p , nd A piner nd McC rthy p his is the type th t is s y e ing referenced hen the ter tinnitus is used

here re se er tre t ent options i e to tinnitus p tients s ch s tinnitus Retr iving her py R s ing p ific tion nd i iting tinnitus ind icing gents nd en iron ent f ctors R in o es h it ting the p tient s re ctions to tinnitus r ther th n tte pting to e i in te the so nds Loc ood S i nd B r rd R in o es co nse ing nd ed ic ting p tients nd using so nd ther py e g so nd gener tors or he ring ids to enhance e tern so nds stre off nd H ze p nd tinnitus Association of C n d

tinnitus s ing is nother for of tre t ent th t s ppresses tinnitus y using e tern so nd to reduce tinnitus perception stre off nd H ze p nd ohnson , p , De ices used to produce tinnitus s ing effects fit ehind or in the e r nd re s s y orn y nor he ring tinnitus p tients For so e p tients it produces resid i nhi ition or period of tinnitus re ief th t is e per ienced fter s ing h s een re o ed ohnson , p , , hie s ing is co on e thod of tre t ent not p tients e per ience i pro e ent Loc ood S i nd B r rd Gi en th t signific nt n er of indi id s ith tinnitus h e he ring oss p ific tion c n so e used s tre t ent So e studies h e reported tinnitus re ief in of p tients ho used he ring ids though the re son for this is in no n nt nd Sper ing , nd stre off nd H ze Other tre t ents in o e i iting f ctors th t contri ute to tinnitus inc iding e pos re to o d noise nd using s ing techniques s ch s soft hite noise t night to pro ote s eep nt nd Sper ing , P tients y so e instr cted to discontin e the use of tinnitus ind icing dr gs nd to n ge et o ic or diet ry disorders high y in o e the oid nce of nicotine choco te coffee or te nt nd Sper ing , he n ge ent of cti e r conditions c n so i pro e tinnitus nd y e s si p e s using topic nti iotics to tre t otitis e tern nt nd Sper ing , nd S nder ,

Objective

he pri ry o ecti e of this p per is to critic y e a te the effic cy of tr , high frequency one

Methods

Search Strategy Computerized databases including MEDLINE SCOPUS CINAHL and PsycMed were searched using the following search strategy: high frequency OR ultrasonic OR ultrahigh frequency OR high frequency bone conduction OR tinnitus AND tinnitus. The search was limited to English and Humans.

Selection Criteria Studies included in this review examined the use of ultrahigh frequency stimuli with increased frequencies (i.e., > 10,000 Hz) delivered via bone conduction for the treatment of tinnitus. Review articles were not included. Only studies were selected by reviewing abstracts to determine which articles met the inclusion criteria. The reference lists in the articles selected were also examined.

Data Collection The results of the literature search yielded eight articles for inclusion in the review. Five single group studies with pre-posttest experimental design, one of which also included single subject case study, one nonrandomized clinical trial cohort study, and two prospective crossover experimental studies with within groups repeated measures design.

Results

Study #1. Goetsch Shinn Lenhardt Richards Madsen and Goint examined the residual inhibition of tinnitus following treatment with the device in patients with mild to moderate high frequency hearing loss and severe disabling high pitched tinnitus. The study used a single group, pre-posttest experimental design.

The treatment consisted of digitally processed music that was used to modulate 10,000 Hz signal delivered via bone conduction transducer to the stapes. The stimulus was presented at 10 dB above each subject's threshold. The subjects listened to the stimulus for 10 minutes, increasing to 15 minutes daily twice a day for four weeks. Audiograms and tinnitus pitch matching procedures were performed pre and post treatment and questionnaire administered 1 month after the end of treatment. Based on the results of the questionnaires, subjects reported a 50% improvement in their tinnitus and the duration of the improvement ranged from 1 week to 1 year, with 50% of subjects reporting no residual inhibition of the tinnitus. There were no significant changes in the patients' audiograms following treatment.

This study did not include randomization or controls. No statistical analyses were reported. The results should therefore be interpreted with caution.

Study #2. Lenhardt Goetsch Shinn and Goint examined the effectiveness of the device for tinnitus treatment in research report that included different studies.

single tinnitus and ordering its loudness when standard irritants were used. However, the gnetostriction transducer is ineffective as it does not comfortably radiating treatment.

The study did not use randomization or controls nor did it provide sufficient information about the measures used to evaluate treatment outcomes. Statistical analyses were not reported and the sample sizes for each participant in this study were small.

Study #3. Shalton Strahan, Aileen Lenhardt, and Godstein used positron emission tomography (PET) as a monitoring system to compare brain activity before and after the use of a high frequency tinnitus therapy. They also compared the PET data with subjective hearing responses of the subjects. The study used a single group pre-posttest experimental design. All participants experienced subjective idiopathic tinnitus and were randomly selected from 100 participants who were receiving therapy. The experimental group then received 100 treatments with the therapy device for a period of 10 weeks. All participants were evaluated according to a medical audiology tinnitus protocol which includes a high frequency and conventional audiometry self-administered tinnitus questionnaires, tinnitus pitch and loudness matching and initial single ear measures. PET scans were performed 1 week prior to treatment and within 10 hours of the final treatment. PET scans were analyzed for the 6 regions of interest (ROI) in the left and right thalamus, the temporal auditory primary and frontal lobes and the cerebellum. The Bonferroni correction for multiple tests was used and it was reported that normalized data for interhemispheric differences in the cerebellum, left and right were significant pre-treatment but were not significant post-treatment. However, based on the significance level used, it appears that the pre- and post-treatment interhemispheric differences in the cerebellum were not significant. There were no significant differences found before or after therapy in either ROI. Subjects reported varying degrees of tinnitus intensity on the questionnaires and initial single ear measures were found to be significantly reduced. The best subjective reports were from participants with thresholds of 20 dB or less from 1000 Hz. The authors concluded that the correlation between PET changes in initial single ear hearing and high frequency audiograms and the subjective reports suggest that treatment induced neuronal

received the same treatment with only small differences in the treatment periods and no controls were used. In addition, the study did not provide sufficient information about the measures used to evaluate treatment outcomes.

Study #5. Gostein, Shinn, and Lenhardt presented the results of their patient selection criteria for predicting success in patients receiving ultrahigh frequency therapy with the *phonoc* device or ultrasonic acoustic therapy with the *phonoc* device.

