Effect of Voice Treatment Supplemented with Transcranial Magnetic Stimulation on Voice Periodicity in Parkinson Disease

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Effects of Lee Silverman Voice Treatment (LSVT) supplemented with transcranial magnetic stimulation (TMS) upon phonatory periodicity as well as overall intensity were examined in 18 participants with Parkinson disease. Prior to voice therapy, excitatory TMS was administered to either the right motor strip (RTMS), left motor strip (LTMS) or in a sham TMS (STMS) condition which was most comparable to standard LSVT. Recordings of sustained vowels and Rainbow Passage readings were obtained on two different days before and after treatment and at follow up (FU). Cepstral Peak Prominence (CPP) and overall intensity (dB) were measured on each of the six days, 2 pre, 2 post and 2 FU. CPP is a measure of voice periodicity that can be used with connected speech as well as with sustained vowels, and is independent of period-based F0 tracking. For each speaking task, results indicated statistically significantly increased overall dB from pre-to-post LSVT that was maintained at FU. This was in keeping with expectations following LSVT. Additionally, CPP was significantly increased from pre-to-post treatment and was maintained at FU. Differences between RTMS, LTMS and STMS groups were also examined.

This study examined changes in voice periodicity in speakers with idiopathic Parkinson Disease (PD) before and after combined modality treatment with Transcranial Magnetic Stimulation (TMS) and Lee Silverman Voice Treatment (LSVT-LOUD^{TM}) (Ramig, et. Al., 1995). We questioned whether TMS administered to the cortical larynx area of the motor strip (M1) of the left hemisphere (LTMS) vs that of the right hemisphere (RTMS) would enhance the effect of LSVT on periodicity in comparison with LSVT combined with a sham TMS condition (STMS). Cepstral peak prominence (CPP) is an acoustic index of periodicity that is based on an intensive algorithm that assess the degree of harmonic energy in the voice signal. CPP is independent of period-based F0 tracking, which may be invalid in speakers with significant dysphonia and is also less applicable to connected speech. Although it has been demonstrated that LSVT improves many aspects of voice production (e.g., subglottal pressure, vocal fold closure, perceived voice quality), in addition to voice intensity (dB), there has not been direct acoustic assessment of periodicity using the CPP for the combined modality treatment of TMS/LSVT in PD.

Eighteen participants with diagnosis of PD ranging in age from 50 – 78 years were quasi-randomly assigned to the three TMS groups (n = 6). All participants were determined to have hypophonia and those with more than mild depression or cognitive impairment were excluded. All participants maintained their medication schedules throughout the study and none had previously received LSVT or TMS. Each patient was recorded on two different days at each time period, pre-tx, post-tx, and at 3-month FU. Recordings were obtained in a sound treated booth using a Countryman head-mounted microphone positioned 6 cm out of the breath stream. Tasks included production of 3 trials of sustained vowel “ah” and reading of paragraph of the Rainbow Passage (RBP). Signal were digitized directly to disc using the KayPENTAX CSL Model 4500 at 50 kHz sampling rate. Intensity (dB) was measured using the LSVT Companion^{TM}. CPP measures were obtained with *Assessment of Dysphonia in Speech and Voice* (ADSV) software (Awan, 2011).

TMS was administered by a clinical neurophysiologist using the Nexstim Neuronavigation TMS system. For TMS groups, the treatment consisted of a total of 3000 pulses delivered at the

rate of 5 Hz with intensity of 80 V/m to the primary motor cortex (M1) larynx area in the LTMS and RTMS conditions, but at < 25 V/m in the STMS. M1 locations were determined via MRI/fMRI co-registration. Sham TMS was applied in the same manner as "real TMS", but with a spacer, 30 mm thick placed between the TMS coil and the subjects' scalp, such that the feeling of the TMS coil on the scalp and the sound from the TMS coil are similar to the real TMS condition, but without cortical stimulation. STMS was most comparable to standard LSVT alone. TMS was applied no more than 90 minutes prior to LSVT. LSVT was administered by a certified speech-language pathologist, also certified for LSVT, according to standard protocol for 16 one-hour sessions across 4 weeks.

Results indicate significant improvement in both dB and CPP from pre-to-post treatment that was maintained at FU for sustained vowels and for RBP reading ($P < .01$) for all subjects combined. Although there was no significant TMS group X treatment period interaction, between group changes from post LSVT to FU were suggestive: RTMS showed decreased dB and CPP at FU, LTMS showed increased dB and CPP at FU, while STMS was stable from post to FU. Although TMS group differences didn't attain significance, given small sample size per group, completion of additional participants is planned prior to the conference. Implications of these findings will be discussed.

Awan, S.N. (2011). *Analysis of Dysphonia in Speech and Voice (ADSV ™)*. Montvale, NJ: KayPENTAX.

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