

The Long-Term Effects of the SpeechVive Device for Speakers with Parkinson's Disease

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Background

Over 80% of individuals with Parkinson's Disease (PD) develop speech impairments. Perceptually, speakers with PD develop hypokinetic dysarthria, characterized by increased speech rate, reduced loudness, and a hoarse, breathy vocal quality¹.

The respiratory and laryngeal subsystems play crucial roles in the production and maintenance of steady subglottic air pressure and vocal intensity during speech. People with PD experience physiological changes to these systems which compromise speech production. Compared to healthy adults people with PD:

- Have weaker and less coordinated respiratory muscles⁵
- Use greater abdominal muscle contributions⁶
- Rely on greater amounts of active than passive forces⁶
- Have bowed vocal folds that do not close rapidly or completely

The SpeechVive device shows promise to be an effective speech treatment for people with PD. The SpeechVive is a wearable device which elicits the Lombard Effect during speech by playing multi-talker babble noise. The SpeechVive has previously been found to:

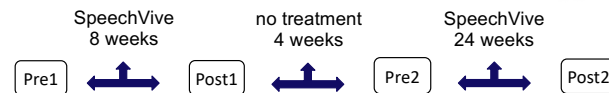
- Improve the efficiency of speech breathing⁸
- Increase vocal intensity and laryngeal aerodynamics⁸

While the short-term effects of the SpeechVive are known, the present study examines long-term effects of the SpeechVive device on respiratory and laryngeal speech functions for speakers with PD.

Methods

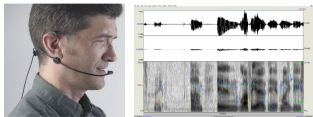
Participants and procedures:

- 12 individuals with PD (9 males, 3 females)
- Mean age= 71.25 years (SD= 6.37 years)
- 2-minute monologue (acoustic and respiratory data)
- Carrier sentence (laryngeal data)



Acoustic Data

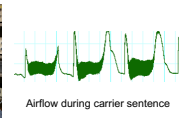
Acoustic Variables



- Sound Pressure Level (SPL)
- Utterance Length (# of syllables)
- Speech and articulation rates
- Pause patterns (# of pauses, % breath pauses, % non-breath pauses, average duration of pauses)

Laryngeal Data

Laryngeal Variables



1. Maximum flow declination rate
2. Open Quotient
3. AC flow
4. DC flow

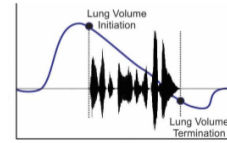


Respiratory Data



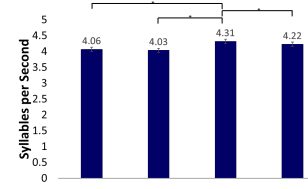
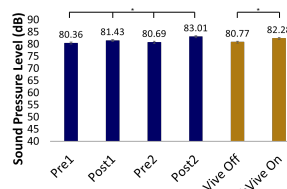
Respiratory Variables

- % vital capacity per syllable
- Lung volume initiation
- Lung volume termination
- Lung volume excursion

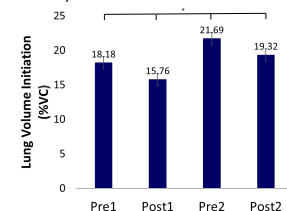


Mixed model ANOVA with repeated measures, subject as a random factor. Session (Pre1, Post1, Pre2, Post2) and condition (SpeechVive off/SpeechVive on) were included as factors. Significant effects were examined post-hoc using Tukey's honestly significant difference (HSD).

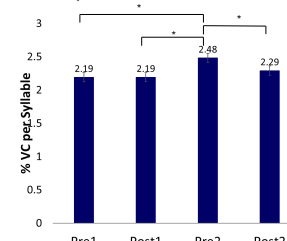
Results



SPL: Main effect of condition ($p < .0001$; off < on) and session ($p < .0001$; Pre1 < Pre2 < Post1 < Post2).

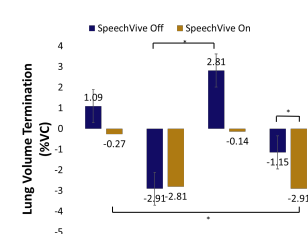


LVI: Main effect of session ($p < .0001$; Post1 < Pre1 < Post2 < Pre2).

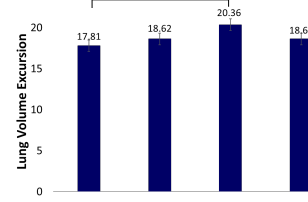


%VC per Syllable: Main effect of session ($p = .0051$; Pre1, Post1, and Post2 < Pre2).

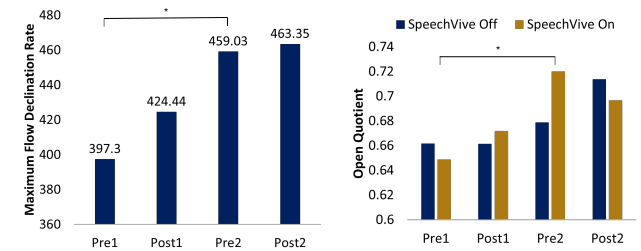
Speech Rate: Main effect of session ($p = .0092$; Pre1 < Pre2; Post2 < Pre2).



LVT: Main effect of session ($p < .0001$) and a session x condition effect ($p = .0031$; Post1 off < Pre2 off; Post2 on < Pre1 on; Post2 off < Post2 on).

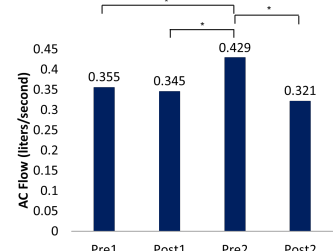


%LVE: Main effect of session ($p = .0004$; Pre1, Post1, and Post2 < Pre2).

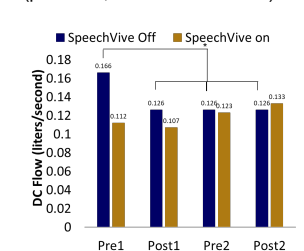


MFDR: A main effect of session ($p = .0122$; Pre1 < Pre2).

OQ: A session x condition effect ($p = .0034$; Pre1 on < Pre2 on).



AC flow: A main effect of session ($p = .0002$; Pre1, Post1, Post2 < Pre2).



DC flow: A session x condition effect ($p = .0006$; Post1 off, Pre2 off, Post2 off < Pre1 off).

Discussion

- Long-term use of the SpeechVive is a viable speech treatment source.
- Speech breathing becomes more efficient. Speakers take advantage of higher recoil forces.
- Loudness continues to increase both with and without the SpeechVive on.
- Speech rate approaches normative and baseline values during the long term-treatment phase.
- Speakers use more laryngeal valving to increase loudness.
- Users of the SpeechVive do not acclimate to the device.

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- NIDCD-R01DC9409

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