A New Treatment, SpeechVive™, for Patients with Parkinson’s Disease

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How does Parkinson’s Disease affect speech and voice?

- Up to 90% of individuals with PD will have speech or voice impairments

- **Perceptual features:**
  - Reduced loudness (hypophonia)
  - Breathiness
  - Monotone (reduced pitch and loudness variation)
  - Disordered rate and short rushes of speech
What are the available treatments for speech impairments?

- Adduction exercises
- Vocal function exercises
- LSVT® LOUD: only behavioral treatment on the market with strong clinical efficacy data with individuals with Parkinson’s disease

- All behavioral treatments are difficult to implement with moderate to severe patients because they do not carry-over the effects into everyday life consistently
What are the problems with self-perception in PD?

- May not perceive their speech and voice problems as severely as their communication partners

- Individuals with PD may have difficulty appropriately perceiving their own loudness

- May explain why patients have difficulty implementing therapy strategies in everyday communication
How can we cue them to speak louder?

- Lombard Effect:
  - Use of noise to elicit louder and clearer speech spontaneously
  - Preserved in patients with PD
  - Produced the highest SPL speech from both groups
- Patients perceive speaking in noise as easy
- This effect drove the development of the SpeechVive™

Sadagopan and Huber (2007)
SpeechVive™ Prototype Design

• Portable device designed to improve speech and communication in patients with PD

• Uses the Lombard Effect
  • No cognitive demand on patient to remember to talk louder; it is automatic

• Voice activated device
  • Accurate detection of the user’s speech turns multi-talker babble noise on and off
• Multi-talker babble plays monaurally during patient speech
  • Non-occlusive ear fitting
  • Minimal impact on listening
• Follows principles of motor training: overload, daily practice (intensity), and specificity
• Normal day-to-day settings become a training situation to improve speech and communication
Clinical Study of SpeechVive™

- NIH NIDCD funded study
- Data collection across three sites, West Lafayette and Indianapolis, Indiana and Buffalo, New York
- Pre-training (data collection) on at least two different days
- Use the SpeechVive™ daily for an 8-week training period
- Followed by a 4-week detraining period
- Then a 6 month follow-up (optional for patient)

- 39 patients have enrolled in the study
- 37 have completed the initial study (pre-training, 8 weeks of training, and 4 weeks of detraining)
Subject Characteristics

- H&Y Stage II-IV with predominantly III-IV (moderate to severe motor impairments)

- Mild-severe speech impairments, with predominantly moderate-severe impairment pre-training

- All patients except one on Levodopa medication
  - However, medication does not remediate speech symptoms well

- 5 patients with Deep-Brain Stimulator (DBS) implants
  - DBS is often detrimental to speech, swallowing, and cognition
What training was provided?

- Patients were fitted with a SpeechVive™ device
  - Intensity output of the SpeechVive™ set to elicit an increase of 3-5 dB from patients during conversation

- Wore the device in communicative contexts 2-8 hours/day, 7 days/week
  - Included reading for 30 minutes per day, 5 days/week

- SpeechVive™ intensity output was reset every 2 weeks
- Noise output from SpeechVive™ did not exceed 78 dB SPL
Example Effect of SpeechVive™

• Patient with Parkinson’s disease
  • Comfortable and then with the SpeechVive™
  • Patient’s first time using the SpeechVive™
• Is currently on medication for PD and uses a deep-brain stimulator
Sample Comments from patients about the SpeechVive™

- People no longer spoke over me like I was not there
- I got more respect from people because I could talk better
- It was a reminder to speak louder
- My wife said I pronounced words better, more clearly
- My kids thought I had a good voice after using the device
Communication Ratings Improved

Mean CETI-M Score

<table>
<thead>
<tr>
<th></th>
<th>Pre</th>
<th>Post</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parkinson's disease</td>
<td>4.5</td>
<td>5</td>
</tr>
<tr>
<td>Communication Partners</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

n = 37 subjects
Example Effect of 8 weeks on SpeechVive™

- Likely that this patient has PSP
- Pre-therapy at comfortable
- Undergo 8 weeks of training—wearing the SpeechVive™ daily
- Post-therapy at comfortable
Sound Pressure Level Improved

n = 34 subjects
Individual Subject Results for SPL

- **Mlm03**: Decrease in Sound Pressure Level (SPL) from Pre Comf to Post Comf.
- **FDe21**: Increase in SPL from Pre Comf to Post Comf.
- **FDe31**: Increase in SPL from Pre Comf to Post Comf.
- **MDe06**: Decrease in SPL from Pre Comf to Post Comf.
- **Mlm25**: Increase in SPL from Pre Comf to Post Comf.
Speech Rate Changed

Increased Rate

Decreased Rate

n = 16 subjects

n = 18 subjects
Individual Subject Speech Rate Results
SpeechVive™ improves the speech of patients with DBS
Measurements in Progress

- 10 listeners rating:
  - Speech Intelligibility test
  - Overall speech severity (VAS rating)
  - Word Identification

![Graph showing mean VAS scale rating with error bars for different conditions: Pre Comf, Pre with Device, Post Comf, Post with Device. The x-axis represents different conditions, and the y-axis represents the mean VAS scale rating.]
Summary

- Based on data from 39 patients over the last 3 years, we are seeing improved communication: increased vocal intensity, reduced speech rate, and/or improved speech clarity
  - Patients show different patterns of improvement

- Some patients are showing an effect of the training even when they are not wearing the SpeechVive™
- Some patients need to wear the SpeechVive™ continuously
- Data suggest that training for longer, 3-4 months, may be better than 8 weeks
Future Directions

• Improve design
  • Smaller
  • No cords
  • Less visible

• Rechargeable

• Able to generate noise to 80 dB SPL

• Clinician software for setting device and generating reports

• Optimization of training duration and algorithms for training
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Questions?
SpeechVive™ improves speech of severe patients (H&Y stage III)

![Graphs showing mean sound pressure level and mean speech rate pre and post with and without device for Mlm30 and FDe31 stages.](image-url)