A comparison of in-person and telemedicine treatment modalities using the SpeechVive device

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Introduction

- Parkinson disease (PD) is a neurodegenerative disorder that affects multiple systems including the motor, cognitive, sensory systems including those underlying speech. PD results in hypokinetic dysarthria which is associated with decreased loudness, imprecise consonants, and increased rate[1].
- One of the few speech treatment options available for people with PD is the SpeechVive device. This is a wearable device that triggers the intact Lombard effect and has been shown to increase sound pressure level (SPL) in patients both immediately[2].

Figure 1: The SpeechVive device

- Telehealth has become increasingly popular for people with PD, especially those living in rural areas. It has been shown across multiple disciplines, including speech pathology, to be effective and preferred for people with PD. However, there has been significantly less research in the field of speech and little to no implementation data available[3-5].

Objectives

Compare outcomes for the SpeechVive Device across telehealth and in person modalities

Hypothesized that people with PD would perform similarly in both groups.

Utilized an implementation study design to test efficacy of the treatment in real-life conditions.

Methods

- Enrolled 66 participants and their caregivers to participate in the study after completing informed consent.
  - A total of 51 participants (23 telehealth and 28 in-person) completed the study.
  - Inclusionary criteria: dysarthria associated with PD, stimulable to the Lombard effect, had a caregiver with normal cognition (MoCA) willing to participate, a desire to participate in therapy, and the telehealth group needed a computer and reasonable internet speed.
  - Exclusionary criteria: severe depression, neurological disease other than PD.
- Clinically certified speech-language pathologists (SLP) provided developed treatment plans and administered treatment according to goals set by the clinician, including other adjunct therapies.
- The device was programmed for each person to elicit a 3-5 dB SPL increase in conversational speech.
- Patients were asked to wear the device 2-8 hours a day during times they would be communicating and read aloud with device for 30 min/day 5 days/week.
- Assessments occurred at the beginning, after 6 weeks and after 12 weeks of treatment.
- Participants completed speech tasks both on and off the device pre- and post-treatment.
  - Reading passage (Rainbow Passage)
  - Monologue
- All participants completed SpeechVive satisfaction surveys after treatment.
- Telehealth participants completed additional telehealth satisfaction survey.

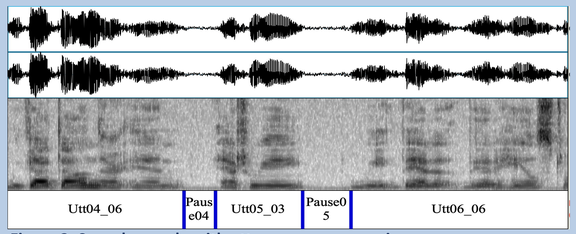

Figure 2: Speech sample with utterance pause parsing

- Data was orthographically transcribed and analyzed for sound pressure level (SPL), syllables per utterance, pause length, and pause duration by undergraduate researchers.
  - Pauses were defined as a period greater than 150ms without speech and used as utterance boundaries.
  - SPL, and utterance duration were calculated with a Praat script[6].
- Data from both groups (telehealth: 84/220 and in-person 54/252) was lost due to signal skipping, recording errors from software malfunction or user error, overlapping speech, and/or background noise.

Results

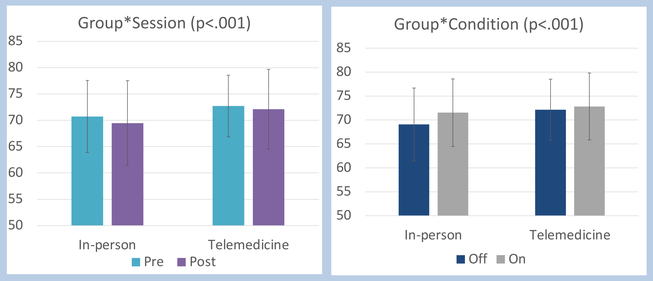

Figure 3: Sound Pressure Level (dB SPL)

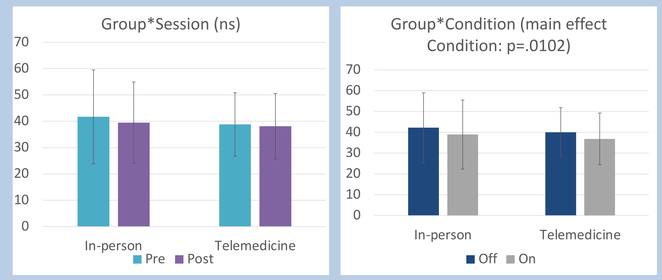

Figure 4: Number of Pauses

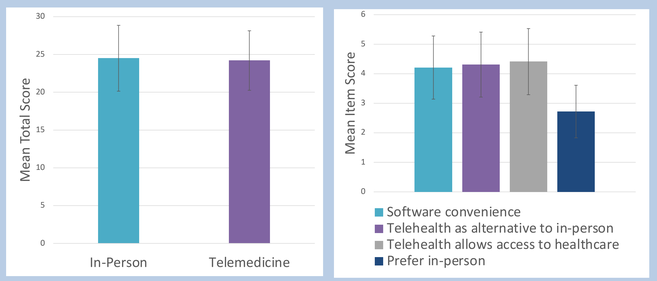

Figure 5: SpeechVive Satisfaction

Figure 6: Telehealth Satisfaction

- Linear mixed model ANOVAs were used to determine effects with the subject as the repeated factor, SLP as the random factor, and the session (pre/post) and condition (on/off) as the within-subject factors. Tukey HSD tests were utilized to determine any significant interaction effects.
  - SPL measures showed significant group by session ($p<.001$) and group by condition ($p<.001$) effects.
  - Pause measure data showed significant main effect of condition ($p<.0102$).
- Wilcoxon non-parametric statistics were used to determine significance in both the SpeechVive and telehealth survey data. Both surveys had participants rate from 1 (strongly disagree) to 5 (strongly agree).
  - The device satisfaction survey allowed participants to rate satisfaction across 6 questions for a maximum score of 30. No statistically significant difference was found between the two groups ($p=.059$). 4 participants did not complete the survey and there was 1 missing value.
  - Telehealth satisfaction was 14 questions and a total maximum score of 70. The average score was 58.8 (SD=11.4) with a range between 26-69. 2 subjects did not complete it and 5 subjects had missing values.

Discussion

- The SpeechVive showed improvements in SPL for the in-person group but less effectiveness when administered via telehealth.
  - Significant SPL training effects are not seen.
  - Considered to be a prosthetic.
- Decreased pause frequency means speakers are less likely to be interrupted or lose conversational turns.
- Overall therapeutic effect was greater in person.
- Satisfaction with device and telehealth was consistent with prior literature.
- Overall, more research is needed to determine the efficacy of speech therapy via telehealth for people with Parkinson.
- This study was limited by technological issues that resulted in data loss and variability in therapy inherent in the implementation study design.

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