Treatment of Speech Impairments in Parkinson's Disease

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Assessment and Treatment of Individuals with Parkinson’s Disease

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Treatment of Speech Impairments in Parkinson’s Disease

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Overview

• Background on Parkinson’s disease
• Speech impairments associated with Parkinson’s disease
• Treatments for speech impairments in individuals with Parkinson’s disease
Acknowledgements and Disclosures

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Background on Parkinson’s Disease

- Progressive movement disorder in which there is a deficit in dopamine production in the substantia nigra of the basal ganglia
- Affects about 1-1.5 million people in the U.S. (Yorkston et al, 1999)
- One of the most common degenerative diseases of neurological origin (Burn, 2000)
- Cause is unknown
- Has far reaching effects on the motor and cognitive systems, resulting in speech and language problems
Parkinson’s Disease

- In diagnosis, patient must demonstrate 2/4 classic motor signs: Resting tremor, rigidity, akinesia/bradykinesia, or loss of postural reflexes
- Reduction in production of dopamine in the brain
  - Due to death of dopamine producing cells in the basal ganglia (especially the substantia nigra) and the brainstem

Causes of Parkinson’s Disease

Aggregation of α-synuclein and mitochondrial damage are potential causes of neuronal death in PD, including dopamine producing cells

Course of Parkinson’s Disease

Images taken from:
- niehs.nih.gov
- larafriends.com
- Braak et al. (2004)
- Obeso et al. (2010)
Progression of Disease

- Pre-Diagnostic:
  - Subtle neurological features: Small, slow movements; soft, monotone voice; tremor

- Pre-Motor:
  - Non-motor features: Olfactory loss, depression, cardiac, visual, gastrointestinal function, REM disorder

- Pre-Clinical:
  - Abnormalities on imaging markers (SPECT); imaging abnormalities precede neural symptoms

- Pre-Physiological:
  - Genetic mutations; high risk for PD; no motor or non-motor features of PD

Impact on Speech

Effect on Speech Production

- 89% of people with Parkinson’s disease will develop voice problems (Logemann et al, 1978)

- 45% of people with Parkinson’s disease will develop articulation problems (Logemann et al, 1978)

- People with PD sometimes don’t recognize that they have speech problems
Effect on Speech Production

- Perceptual features (Darley et al., 1969):
  - Reduced loudness (hypophonia)
  - Breathiness (whispery sound to voice)
  - Hoarseness (gravely sound to voice)
  - Monotone (reduced pitch and loudness variation)
  - Fast rate and short rushes of speech
  - Disfluencies

Hypophonia

- Sound pressure level (SPL) is the physical correlate of loudness
- Some individuals with PD have a lower SPL
- Impact: Communication partners are hearing impaired, exponentially increasing the effect on communication

Monotone Voice

- Fundamental frequency (F₀): physical correlate of pitch
- Reduced F₀ range and variability
- Reduced marking of stressed words or focus of sentences
Monotone Voice

- Reduced distinction between questions and statements
- Reduced marking of final and non-final clause boundaries
- **Impact:** Reduces listeners' ability to parse incoming speech signal

Changes to Speech Rate with Disease Progression

- Shorter utterances
- Faster speech rate
- **Impact:** Harder for listeners to distinguish sounds and words, less time to comprehend incoming speech

PD: Self-Perception

- May not perceive their speech and voice problems as severely as their communication partners
- Individuals with PD have difficulty accurately perceiving their own loudness
- Do not perceive speech errors as accurately as control subjects
- **Impact:** Therapy is difficult because we need to teach them that their speech is impaired
Assessment and Treatment of Individuals with Parkinson’s Disease

Cueing

- **External cues:** Visual or auditory feedback to perform a task
- **Internal cues:** Unconscious information or self-cueing guides task performance

Improvements in gait patterns have been shown in response to both external and internal cues:
- Internal cues did not generalize as well as external ones
- Similar findings for handwriting and speech as in gait

Cueing

- Some cues work better than other cues for achieving a specific goal
- Most speech therapy for people with PD aims to improve loudness or rate

**Impact:** The cues used in therapy will affect the outcome

Additional Difficulties in PD
Cough Strength is Affected by PD

- Pitts, Bolster, Rosenbek, Troche, and Sapienza (2008) found that patients with PD who had swallowing difficulties demonstrated changes to cough dynamics, including
  - Longer compression phase duration
  - Slower expiratory rise time
  - Decreased expiratory peak airflow
  - Decreased cough volume acceleration
- All of these changes are likely to result in reduced clearance of penetration and aspiration

Balance Problems in PD

- 50-70% of individuals with PD have fallen (Wood et al, 2002)
- Many of these individuals suffer debilitating injuries from their fall, drastically reducing their overall mobility (Kannus, 2005)
- Even when a serious injury is not sustained, individuals with PD often lose confidence in their own balance and have a large fear of falling
- Such a fear causes these patients to limit their daily activities and therefore negatively affects their overall quality of life

Cognitive Changes in PD

- May be present in subtle ways before diagnosis is made
  - Dopaminergic cell loss begins 4-6 years before onset of motor symptoms, and diagnosis is based on motor symptoms
  - Cognitive deficits are seen at first diagnosis, and do not progress as rapidly as motor symptoms post diagnosis
  - May be markers of early premotor PD
- Later in disease, these non-motor symptoms can be the major factor affecting quality of life
Cognitive Changes in PD

- Deficits in visuospatial skills, memory, language, attention, mood, and emotional processing (Zgaljardic et al, 2003 and 2006)
- Problems developing their own plan of action or initiating and maintaining goal-directed behavior, along with concept formation and self-monitoring behavior (Zgaljardic et al, 2003 and 2006)
- Problems with dual tasking and prioritization of secondary tasks
  - This may play a role in falls in individuals with PD

Treatment

PD: Medical Treatment

- Medical Treatment is usually pharmacological
  - L-dopa crosses blood brain barrier to produce dopamine in the brain
  - Does not remediate speech symptoms well
- Deep Brain Stimulation is a common surgical treatment for later-stage patients
  - Helps tremor very much
  - Is often detrimental to speech, swallowing, and cognition
Lee Silverman Treatment Program

- Lee Silverman Treatment Program (LSVT® LOUD) (Ramig et al, 1995 and 1996)
  - Intensive, 1 hour per day, 5 days per week, for 4 weeks
  - Clinician instructs the patient to talk more loudly, to use high effort
  - Clinician will work to help the patient with PD perceive their new louder voice as normal for them
  - Practice 10 functional phrases the person uses in everyday life which are used to cue the person to talk louder everyday, outside of therapy
  - Daily home practice is required

LSVT® LOUD

- There is a large body of literature to support its use
- Improvements in voice, articulation, and communicative competence when the patients speak more loudly
- The effects can last 6 months to a year without additional therapy for some patients

LSVT® LOUD

- LSVT® LOUD has limitations, however
  - Generalization to everyday activities is difficult for some patients (Countryman & Ramig, 1993)
  - Large body of literature has shown that external cues are more effective than internal ones for individuals with Parkinson's disease
  - Because Parkinson's disease affects cognitive function, it is difficult for individuals with PD to remember to talk more loudly
  - May not be appropriate for individuals who fatigue and may not be able to handle the intensive nature of the therapy
  - Many people live too far from a trained, certified clinician
Expiratory Muscle Strength Training

- Set to 70% of the patient’s maximum expiratory pressure or the highest level the patient can tolerate
- Patient completes:
  - 5 breaths through the device, 5 times per day
  - 5 days per week
  - For 4-5 weeks
- Device setting is increased as the patient improves
- c.f.: Sapienza (2008)

EMST Improves Cough Dynamics

SpeechVive

- Investigational device
- Worn by the individual with PD in one ear
- Plays multi-talker babble in one ear when the person talks, eliciting the Lombard effect
- Potential to lead to increased vocal intensity and speech clarity without requiring the person to attend to changing speech.
SpeechVive Study: Subject Characteristics

- Age: 67.67 years
- Time Since Diagnosis: 8.67 years
- Hoehn & Yahr (disease state): 2.62 (out of 5)
  - 4 of these subjects had a deep-brain stimulator
  - 1 of these subjects had undergone a pallidotomy and thalamotomy
- Pre-treatment speech severity: Moderate
- 14 participants had previous speech therapy
  - Of those 14, 8 had LSVT previously

SpeechVive

- 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 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

Baseline Changes in Sound Pressure Level

<table>
<thead>
<tr>
<th></th>
<th>Start of Baseline</th>
<th>End of Baseline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sound Pressure Level</td>
<td>80</td>
<td>83</td>
</tr>
</tbody>
</table>

Treatment Changes in Sound Pressure Level

<table>
<thead>
<tr>
<th></th>
<th>Pre-treatment</th>
<th>Start of Post-treatment Sessions</th>
<th>End of Post-treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sound Pressure Level (dB)</td>
<td>77</td>
<td>80</td>
<td>83</td>
</tr>
</tbody>
</table>

- Off Device
- On Device
SpeechVive: Results Summary

- Patients and caregivers reported improvements in communicative competence (based on the CETI-M)
- 75% patients improved SPL by the end of treatment
- 90-95% of patients improved in some way (vocal intensity, rate, and speech clarity) by the end of treatment

Alternative to Behavioral Therapy

- Voice Amplification System
- Portable microphone/speaker system which is used to amplify the speakers voice
- Example: Chattervox
  
  http://www.chattervox.com/

Treatment Take Home Message

- PD affects speech and language
- Several treatments have efficacy data demonstrating the ability to improve speech or respiratory function in people with PD
  - LSVT LOUD
  - EMST
  - SpeechVive
- Speech treatments can be mixed together as needed to obtain the best benefit for the patient.
- Voice amplification systems can provide an alternative to (or addition to) behavioral therapy
Questions?

References

References