Parkinson’s Disease and LSVT:  
EFFECTS ON BRAIN FUNCTION, SWALLOWING AND ARTICULATION

Parkinson’s disease (PD), a degenerative disease of the central nervous system, is noted for voice and speech deficits, classified as hypokinetic dysarthria. Dysarthric speech is characterized by vowels that are centralized due, in part, to the limited range of movement of the speech articulators. PD results in disruption of internal cues or trigger of movement. 89% patients with Parkinson’s have disordered speech while only 4% receive speech treatment (LSVT Pamphlet). Countryman and her colleagues (1997) maintain that limited thoracic excursion and problems coordinating the respiratory and laryngeal systems reduce the respiratory volumes needed for speech and contribute to low vocal volume and short rushes of speech - typical symptoms in PD patients.

Symptoms may include:

- Reduced vocal loudness
- Breathy, harsh or hoarse vocal quality
- Reduced prosodic inflection
- Imprecise and reduced range of articulatory movements
- Short rushes of speech
- Decay in vocal loudness
- Reduced articulatory movements toward the end of a phrase or a sentence
- Monotone
- Vocal tremor
- Overall reduction in speech intelligibility
- Sound pressure level: 2-4 dB across tasks
- Phonatory instability
- Glottal incompetence,
  VF “bowing”

Accompanying symptoms:

- Orofacial abnormalities
- Disturbed swallowing
- Reduced facial expression
- Tremors
- Rigidity
- Bradykinesia (slowness of movement)
Hypokinesia (reduced amplitude of movement)  
Laryngeal/respiratory involvement  

TREATMENT OF PARKINSON’S DISEASE

Traditional speech therapy (traditional articulation therapy) as well as pharmacological and surgical methods, have had limited long-term results on people with Parkinson’s disease (PD).

Medical Management:

Pharmacology: Dopamine agonists  
Levodopa

Surgery:  
Fetal cell transplants  
Thalamotomy - tremor  
Pallidotomy: disrupts inhibitory outflow of globus pallidus

Studies show LSVT, through increased vocal effort and loudness, produces marked and long-term improvement on the respiratory, phonatory and articulatory systems resulting in enhanced voice and speech function (Farley, Fox, Ramig & McFarland, 2005; Baker, Ramig, Sapir, Luschei, & Smith, 2001).

LSVT TREATMENT

The Lee Silverman Voice Treatment (LSVT) was designed by Lorraine Ramig and colleagues as a behavioral treatment approach for voice disorders associated with Parkinson’s (Countryman et al., 1997). The protocol maximizes overall speech intelligibility by addressing disordered laryngeal function (e.g., hypoadduction of the vocal folds, phonatory instability, reduced range of motion in laryngeal musculature), improving coordination of the respiratory and laryngeal systems as well as enhancing sensory perception of effort (calibration) (Ramig, Pawlas, & Countryman, 1995).

The emphasis on increased intelligibility through vocal loudness combines high-effort, loud phonatory production, which is reinforced through repetition and an intensive treatment delivery (e.g., 16 sessions, lasting 50-60 minutes, over a one-month period). The success of LSVT is dependent upon changing behavior rather than relying on external cues or stimuli in which the speaker is asked to perform a task (e.g., “say that twice as loud”). Instead, behavior is modified through learning, memory and reliance on self-cueing and self-regulation so that change is sustained over months and even years.
According to Fox, Morrison, Ramig & Sapir (2002), vocal sound pressure level (VocSPL) increased after LSVT, from 8 to 13 decibels in comparison with changes from 1-2 decibels for an alternative treatment. Intensified vocal output improved vocal loudness and quality. Also noted were increased vowel phonation, fundamental frequency variability during speech and increased subglottal air pressure. Improvement of vocal fold adduction was measured by videostroboscopy and laryngeal EMGs identified increased activity in the thyroidarytenoid muscle (Fox et al., 2002).

Furthermore, Sapir, Spielman, Ramig, Story and Fox (2007) conclude that the vowel triangle area (VTA) where vowels are produced in the oral cavity, is significantly reduced (e.g., centralized) during dysarthric speech. Whereas, post LSVT, the vowel triangle area was decentralized which represented an increase in articulatory range and coordination. This outcome supports the theory that LSVT results not just in increased vocal sound pressure levels (VocSPL) but a more precise articulatory system as well (Sapir et al., 2007).

Liotti, Vogel, New, Ramig, Mayberg, Cook, and Fox’s (1999) research, using Positron Electron Tomography (PET), documented a reorganization of premotor regions in individuals with Parkinson’s disease post LSVT. After treatment, they found a reduction in the abnormal activation in the cortical premotor areas as well as greater activation in the basal ganglia and anterior insula region. The researchers (Lotti et al., 1999) suggest that a change from abnormally effortful motor control for labored dysarthric speech towards a more effortless and automatic speech activation in the basal ganglia and anterior insula after LSVT, resulted in the shift in cortical activation sites. Of note, these changes occurred only after LSVT. Stimulated increases in loudness (e.g., “say it twice as loud.”) on a patient prior to treatment produced no changes in the abnormally active cortical sites. Only after LSVT, in which the use of vocal loudness became habitual, did the shifts in cortical activity occur.

A 2002 pilot study (Sharkawi, Ramig, Logemann, Pauloski, Rademaker, Smith, Pawlas, Baum, Werner), examining the effects of Lee Silverman Voice Treatment (LSVT) on swallowing and voice in eight patients with idiopathic Parkinson's disease,
found greater neuromuscular control of the entire upper aerodigestive tract, resulting in improved oral and pharyngeal phases of swallowing.

In conclusion, it appears that the Lee Silverman Voice Treatment has positive effects not only on articulation, phonation and respiration in individuals with PD (e.g., more stable motor output [Smith et al., 1995], increased vowel phonation, increased subglottal air pressure, improvement of vocal fold adduction [Fox et al., 2002], increase in articulatory range, a more precise articulatory system [Sapir et al. 2007]), but also on nonspeech areas as well, such as swallowing (El Sharkawi et al., 2002). LSVT’s emphasis on one area – increased loudness- positively affects respiration, phonation and articulation without directly focusing on those subsystems of speech (Fox et al., 2002). Moreover, a critical part of the treatment protocol, behavior modification, supports significant cortical change as evidenced in shifts in activation sites in the cortex (Lotti et al., 1999).

LSVT TREATMENT

The Lee Silverman Voice Treatment (LSVT) is an intensive behavioral treatment designed originally to treat voice deficits associated with Parkinson’s disease. The emphasis is on increased intelligibility through vocal loudness. The high-effort, loud phonatory production is reinforced through repetition and an intensive delivery of treatment. Treatment: 16 intensive, 50-60 minute sessions, over a one-month period.

Daily Treatment is Essential!

LSVT RESULTS:

Retrained sensory system:
  - Self-perception calibration
  - No evidence of peripheral auditory feedback breakdown
  - Are they overhearing themselves?

Enhanced phonatory effort generates
  - Increased loudness, improved speech production
  - Increased vocal fold adduction and respiratory support
  - Increased vocal sound pressure level (SPL) from 8 to 13 decibels in comparison with changes from 1-2 decibels for an alternative treatment group.
Increased vowel phonation
Decreased centralization of vowels
- increases in articulatory displacement occurred during increases in loudness levels.
Maximum range of fundamental frequency.
Fundamental frequency variability during speech.
Reductions in rate (increased pause time and decreased utterance duration) of speech.
Increased subglottal air pressure.
Improved true vocal fold adduction as measured by videostroboscopy
Increased drive to the respiratory and laryngeal systems increases amplitude of vocal output, thereby improving vocal loudness and quality.
Laryngeal EMGs documented positive increases in the thyroidarytenoid muscle after LSVT.
Increased facial expression accompanying improved loudness and improved intonation following voice treatment voice.
Enlarged oral cavities while producing vowels /a/ and /u/, during loud phonation.
- An emphasized /i/ resulted in an enlarged pharynx.
Correlation between greater jaw movement during emphasized vowels and vocal loudness control.
Improved vocal sound pressure levels (VocSPL).

The 2002 Pilot Study Examining LSVT on Swallowing:

**Method:** Each patient received a modified barium swallow (MBS) in addition to voice recording before and after 1 month of LSVT®. Swallowing motility disorders were defined and temporal measures of the swallow were completed from the MBS. Voice evaluation included measures of vocal intensity, fundamental frequency, and the patient's perception of speech change.

**Results:** before LSVT, the most prevalent swallowing motility disorders were oral phase problems including reduced tongue control and strength. Reduced tongue base retraction, resulting in residue in the valleculae, was the most common disorder in the pharyngeal stage of the swallow. Oral transit time (OTT) and pharyngeal transit time (PTT) were
prolonged. After LSVT, there was an overall 51% reduction in the number of swallowing motility disorders. Some temporal measures of swallowing were also significantly reduced as was the approximate amount of oral residue after 3 ml and 5 ml liquid swallows. Voice changes after LSVT included a significant increase in vocal intensity during sustained vowel phonation as well as during reading.

LSVT seemingly improved neuromuscular control of the entire upper aerodigestive tract, improving oral tongue and tongue base function during the oral and pharyngeal phases of swallowing as well as improving vocal intensity.


REFERENCES


**IMPORTANT MOTIVATION TO MAINTAIN AWARENESS OF EFFORT AND LOUDNESS:**

“STAY LOUD”

“KEEP IT LOUD”

“FEEL THAT EFFORT”

“HEAR THAT LOUDNESS?”
“THAT IS THE AMOUNT OF EFFORT AND LOUDNESS YOU NEED TO USE WHEN YOU TALK”

“How did that feel?”

“How did that sound?”

**DAILY TASKS**

1. **MAXIMUM DURATION OF SUSTAINED VOWEL PHONATION**
   - Improves VF ADDUCTION, LOUDNESS, DURATION OF PHONATION
   - Train RESPIRATORY/LARYNGEAL COORDINATION
   - A. “Take a deep breath and say “AH” in a loud voice and for as long as you can” (15X per day – 15 sec. each)

2. **MAXIMUM FUNDAMENTAL FREQUENCY RANGE**
   - Improves FUNDAMENTAL FREQUENCY RANGE, VF ADDUCTION, LOUDNESS, DURATION OF PHONATION
   - Train RESPIRATORY/LARYNGEAL COORDINATION
   - A. “Do what I do”: (Glides: stair step high to low) (15X per day)
   - B. Open mouth
   - C. Head Up

3. **READING PHRASES** (avoid word lists)
   - A. Patient reads 10 phrases used in everyday life (5X per day)
   - B. Reads using loud “Ah” voice
   - C. Phrases never change
   - D. Include a few emotional phrases

4. **FEEDBACK**
   - Improves awareness and generalization
A. “Did you use your loud “Ah” voice”
B. “Do you feel the effort?”

5. OPEN MOUTH EXERCISES
   Stimulates proprioceptive awareness in jaw and lip area
   A. Over-exaggerate mouth open, retracted, puckered

6. KEEP SHOULDERS RELAXED

7. ISOMETRIC EXERCISES
   A. Push hands together
   B. Pull up/ and or/ Push down on chair

RAY’S DAILY EXERCISES

THINK **LOUD!**  
SPEAK **LOUD!**  
Feel the **EFFORT!**

1. Say “**AH**” **LOUD! 15X**

2. **High** to **Low** Scale  **LOUD! 15X**

3. “**EEEEEEEEEEEEEE**”  “**OOOOOOOOOOOOOO**”  
   **LOUD! 15X**

4. Read “**S**” and “**Z**” phrases  **LOUD! 3X**

5. Read songs  **LOUD! 3X**

6. Sing songs  **LOUD! 3X**
THINK **LOUD!**

SPEAK **LOUD!**

Feel the **EFFORT!**

Remember to **BREATH 2x**!