The Science and Practice of LSVT BIG®: Physical/occupational therapy for Parkinson disease

Erica Vitek, MOT, OTR, BCB-PMD, PRPC

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Objectives of Presentation

• Briefly review Parkinson disease

• Explain advances in neuroscience and impact on the field of rehabilitation

• Discuss development, data and exercises for the efficacious speech treatment LSVT LOUD

• Describe development, data and exercises of LSVT BIG

What is Parkinson Disease?

• Parkinson disease (PD) is a progressive degenerative disease of the brain in which neurons of the basal ganglia (substantia nigra) degenerate/die causing insufficient formation of the chemical called dopamine. With approximately 50-80% loss of these cells, the person will start noticing symptoms of PD.
  • PD is the second most common neurodegenerative disorder, after Alzheimer’s disease.
  • PD belongs to a group of conditions called movement disorders.
Substantia Nigra

Normal Brain

PD Brain

Definitions

- **Dopamine**: Neurotransmitter produced in the substantia nigra; roles and functions of dopamine include mood/behavior, cognition/learning, movement, reward/motivation, and sleep.

- **Idiopathic Parkinson disease (PD)**: This is the most commonly referred to diagnosis, meaning of unknown cause. 85% of PD cases are diagnosed as idiopathic.

Who gets Parkinson Disease?

- Approximately 1.5 million people in the United States have been diagnosed with Parkinson disease, and approximately 60,000 new cases are diagnosed each year.

- Accurate numbers are difficult to obtain because early symptoms, which are often subtle or transient, are sometimes mistaken for symptoms of normal aging.
Who gets Parkinson Disease?

- There is increased risk of PD with advancing age.
- Typically develops after age 65, however 15% are individuals under the age of 50.
- PD affects both men and women in equal numbers, however more so in men with young onset diagnosis.
- The majority of PD cases are thought to be caused by a combination of environmental & genetic factors.

How is Parkinson Disease Diagnosed?

- There is no specific test or marker that can definitively diagnose Parkinson disease.
- Diagnosis can be confirmed at time of autopsy.
- In order to diagnose, a neurologist must perform a standardized neurological assessment as well as identify the presence of at least two out of the first three cardinal motor signs and symptoms.
- The cardinal motor symptoms typically begin on one side of the body and progress to the other.
  - To note: prior to the onset of motor symptoms, individuals may realize that in the past months/years they experienced constipation, vivid dreams, depression, and/or a diminished sense of smell.

Cardinal Motor Signs & Symptoms

- Tremor
- Bradykinesia
- Rigidity
- Postural Instability
Non-motor Symptoms

- People with Parkinson disease also suffer from non-motor symptoms which can be as disabling as the cardinal motor symptoms previously described.
  - These symptoms are likely due to the loss of dopaminergic and nondopaminergic innervation in other brain regions.

<table>
<thead>
<tr>
<th>Motor</th>
<th>Sensory</th>
<th>Cognitive</th>
<th>Autonomic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bradykinesia</td>
<td>Pain</td>
<td>Mood changes</td>
<td>Thermal regulation</td>
</tr>
<tr>
<td>Tremor</td>
<td>Aching</td>
<td>Depression</td>
<td>Sweating</td>
</tr>
<tr>
<td>Rigidity</td>
<td>Restlessness</td>
<td>Anxiety</td>
<td>Urinary dysfunction</td>
</tr>
<tr>
<td>Postural instability</td>
<td>Dizziness</td>
<td>Fainting attacks</td>
<td>Orthostatic hypotension</td>
</tr>
<tr>
<td>Bradyarhythmic gait</td>
<td>Chest discomfort</td>
<td>Paroxysmal</td>
<td>Seizures (tetany)</td>
</tr>
<tr>
<td>Decreased arm swing</td>
<td>Anomia (smell loss)</td>
<td>Dementia</td>
<td>Stridor (whistling cough)</td>
</tr>
<tr>
<td>Lower extremity cramps</td>
<td>Visual perception</td>
<td>Confusion</td>
<td>Fatigue</td>
</tr>
<tr>
<td>Weakness/fatigue</td>
<td>Dystonia</td>
<td>Bradyphrenia</td>
<td>Erectile dysfunction</td>
</tr>
<tr>
<td>Hypophonia</td>
<td>Visual hallucinations</td>
<td>Apathy</td>
<td>Orthostatic hypotension</td>
</tr>
<tr>
<td>Dysphagia</td>
<td>Inanition</td>
<td>Daytime somnolence</td>
<td></td>
</tr>
<tr>
<td>Incoordination/ claudication</td>
<td>Obsessive/compulsive</td>
<td>Insomnia</td>
<td></td>
</tr>
<tr>
<td>Freezing</td>
<td>Decreased self confidence</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Masked face</td>
<td>Micrographia</td>
<td>Decreased eye blinking</td>
<td></td>
</tr>
</tbody>
</table>

Standardized Evaluations

1. Unified Parkinson Disease Rating Scale (UPDRS)
2. Hoehn and Yahr Staging
3. Schwab and England Activities of Daily Living
Standardized Evaluations

- Unified Parkinson Disease Rating Scale (UPDRS)
  - Used by a rater to assess the severity of symptoms along the longitudinal course of Parkinson disease
  - 42 items assessing mentation, mood, behavior, ADLs and motor skills
  - Rated on a 0-4 scale (4 being most impaired)
  - The results of each item are then calculated: the greater the number the greater the disability

<table>
<thead>
<tr>
<th>Stage</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage 1</td>
<td>Unilateral involvement</td>
</tr>
<tr>
<td>Stage 2</td>
<td>Bilateral involvement</td>
</tr>
<tr>
<td>Stage 3</td>
<td>Postural instability</td>
</tr>
<tr>
<td>Stage 4</td>
<td>Assist with ADLs, but still ambulating</td>
</tr>
<tr>
<td>Stage 5</td>
<td>Bed/wheelchair ridden</td>
</tr>
</tbody>
</table>

- Hoehn and Yahr Staging

- Schwab and England Activities of Daily Living
  - Scale is used to determine patient's current level of ADL impairment
  - A percentage scale is used and can be rated by the patient or rater
Schwab and England Activities of Daily Living

<table>
<thead>
<tr>
<th>Percentage</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>100%</td>
<td>Completely independent. Able to do all chores without slowness, difficulty or impairment. Essentially normal. Unaware of any difficulty.</td>
</tr>
<tr>
<td>90%</td>
<td>Completely independent. Able to do all chores with some degree of slowness, difficulty or impairment. May take twice as long. Beginning to be aware of difficulty.</td>
</tr>
<tr>
<td>80%</td>
<td>Completely independent in most chores. Takes twice as long. Conscious of difficulty and slowing.</td>
</tr>
<tr>
<td>70%</td>
<td>Not completely independent. More difficulty with some chores. Three to four times as long on chores for some. May take large part of day for chores.</td>
</tr>
<tr>
<td>60%</td>
<td>Some dependency. Can do most chores, but exceedingly slowly and with much effort and effort. Some impossible.</td>
</tr>
<tr>
<td>50%</td>
<td>More dependent. Help with half of chores. Difficulty with everything.</td>
</tr>
<tr>
<td>40%</td>
<td>Very dependent. Can assist with some chores but few alone.</td>
</tr>
<tr>
<td>30%</td>
<td>With effort, now and then does a few chores alone or begins alone. Much help needed.</td>
</tr>
<tr>
<td>20%</td>
<td>Nothing alone. Can be a slight help with some chores. Severe invalid.</td>
</tr>
<tr>
<td>10%</td>
<td>Totally dependent, helpless. Complete invalid.</td>
</tr>
<tr>
<td>0%</td>
<td>Bedridden. Vegetative functions, such as bowel/bladder and swallowing are not functioning.</td>
</tr>
</tbody>
</table>

Legitimate Therapeutic Options
To provide symptomatic relief; improve function

- **Pharmacological (L-dopa)**
- **Neurosurgical (DBS-STN)**
- **Voice and Body Exercise**

Zigmond et al, 2009

Medication Management

- The main goal of antiparkinson drug therapy is to replenish, mimic, or enhance the brain’s supply of dopamine
- PD symptoms and response to treatment varies widely from one patient to the next (as does the progression of the disease)
- Medication choices and doses must be tailored specifically to each patient
Medication Management

- Diagnosis does not trigger the need for medications
- Avoiding immediate treatment can delay long-term side effects/complications which may interfere with drug therapy years later
- Virtually all the medications have side effects which vary in their pattern and severity
- Timing of the medication administration is key to ensuring the best functional response
- Levodopa (Sinemet® = carbidopa/levodopa) is currently the most effective treatment for motor symptoms
- Non-motor symptoms should be considered as targets for medication treatment as much as the motor symptoms

Levodopa

- Levodopa (L-dopa)
  - Was the first major breakthrough in the treatment of PD
  - Levodopa is converted to dopamine for use by the brain, as dopamine in pure form is unable to cross the blood brain barrier
  - When Levodopa is taken orally, portions of the dose are converted into dopamine by the enzyme DDC (dopadecarboxylase) before it can cross the blood brain barrier
  - Frequent side effects due to peripheral actions of dopamine are:
    - Nausea
    - Tachycardia
    - Vomiting
    - Orthostatic hypotension

Levodopa

- Due to the side effects of taking Levodopa alone it is combined with Carbidopa
- Carbidopa blocks the DDC (dopadecarboxylase) enzyme outside the brain allowing more Levodopa to enter the brain
- Carbidopa in itself has not been shown to produce side effects
- Most patients require 75-100 mgs of Carbidopa per day to effectively allow enough Levodopa to enter the brain
- The representation of the dose appears as Carbidopa (mg)/Levodopa (mg) i.e. Sinemet 25/100 (25 mg Carbidopa/100 mg Levodopa)
Levodopa

- The dosing is highly individualized and varies over time
- As the disease progresses, each dose’s action may decrease, which may require more frequent dosing
- Many years of use may cause patients to develop “on” and “off” times
- Many individuals can experience dyskinesias when the medication effect reaches its peak (i.e.) chorea
- Many individuals can experience slowness when the medication effect reaches its trough (i.e.) freezing, bradykinesia/hypokinesia, akinesia

<table>
<thead>
<tr>
<th>Symptoms that will benefit from L-dopa</th>
<th>Symptoms that do not respond well to L-dopa</th>
</tr>
</thead>
<tbody>
<tr>
<td>R rigidity</td>
<td>Postural instability</td>
</tr>
<tr>
<td>Bradykinesia</td>
<td>Dysarthria</td>
</tr>
<tr>
<td>Tremor</td>
<td>Sexual dysfunction</td>
</tr>
<tr>
<td>Gait</td>
<td>Excessive sweating</td>
</tr>
<tr>
<td>Hypomimia (flat affect)</td>
<td>Neurosensory problems</td>
</tr>
<tr>
<td>Micrographia</td>
<td>Seborrhea (scaly skin)</td>
</tr>
<tr>
<td></td>
<td>Constipation</td>
</tr>
<tr>
<td></td>
<td>Depression</td>
</tr>
<tr>
<td></td>
<td>Anxiety</td>
</tr>
<tr>
<td></td>
<td>Dementia</td>
</tr>
</tbody>
</table>

Wearing-off Phenomenon

- At the peak of the “on” time, patients may experience chorea which can be a sign of “too much” medication
- At the trough of the “off” time, patients may experience freezing and bradykinesia which can be a sign of “underdosing”
It is a “Stunning Time” to be in rehabilitation today

- Basic science evidence for the value of exercise in PD (classically drugs, surgery)
- Identified key principles of exercise that drive activity-dependent neural plasticity
- Demonstrated that exercise can improve brain functioning (neural plasticity) and may slow disease progression
- Exercise is Medicine!

Kleim & Jones, 2008; Ludlow et al, 2008

Animal Models of Parkinson Disease

1. Early matters – neuroprotective
   Use it or lose it!
2. Intensity matters – neurorestorative
   Use it and improve it!
3. Continuous matters – disease modification
   Use it or lose it!
4. Inactivity is prodegenerative!

(Tillerson et al, 2001; 2002; 2003)

Animal Models of Parkinson Disease

1. Early matters – neuroprotective
   If exercise treatment began EARLY before or during dopamine terminal degeneration, exercise reversed the motor symptoms
   Reduction in the loss of dopamine in the striatum

   Use it or lose it!
Animal Models of Parkinson Disease

2. Intensity matters – neurorestorative
   Use it and improve it!
   
   If LATER, 50% or more loss of the dopamine neurons, exercise reversed the motor symptoms
   Caused increased utilization of dopamine

Animal Models of Parkinson Disease

3. Continuous matters – disease modification
   Use it or lose it!
   
   Stopping exercise or adding stress CANCELLED the brain and behavioral benefits gained by exercise

Animal Models of Parkinson Disease

4. Inactivity is prodegenerative!

   Non-use/inactivity EXAGGERATED the symptoms in animals that had “pre-clinical” or non-symptomatic PD
Clinical Implications from Animal Models

• Rationale for early intervention across disease severity that is INTENSIVE, TASK SPECIFIC, CONTINUOUS exercise that is FUN/ENGAGING!

• Inactivity is pro-degenerative

Video Example:

• 59 year old female
• 2.5 years post-diagnosis
• On-meds pre and post video

Pre/post LSVT LOUD (Lee Silverman Voice Treatment)
Intensive physical exercise of speech mechanism

Insert Short Shirley Video Here
Patient case: Bernie

- 71 year-old, diagnosed with Parkinson’s disease in 1994
- Reason for referral: slowness and difficulty walking, history of falls, freezing
- Optimized on PD medications
- Hoehn & Yahr 3

Case Study Outcomes:

<table>
<thead>
<tr>
<th></th>
<th>PRE</th>
<th>POST</th>
</tr>
</thead>
<tbody>
<tr>
<td>Falls</td>
<td>1-2/month</td>
<td>0/month</td>
</tr>
<tr>
<td>Assistive device</td>
<td>Cane</td>
<td>None</td>
</tr>
<tr>
<td>Gait Velocity</td>
<td>0.35 m/s</td>
<td>1.17 m/s</td>
</tr>
<tr>
<td>% of age matched norm</td>
<td>29.6 %</td>
<td>100%</td>
</tr>
<tr>
<td>Endurance</td>
<td>730 ft</td>
<td>1200 ft</td>
</tr>
</tbody>
</table>

- To improve his walking
- To go to the movies
- To play with his grandchildren
- To go out to dinner with friends and family
Where did we begin...

“If only we can hear and understand her”
Family of Mrs. Lee Silverman 1987

25+ year journey from invention to scale-up
Over 8 million dollars in NIH funding

Phase I II
1987-89: Initial invention; Pilot data (Scottsdale)
1989-91: Office of Education OE-NIDRR
1991-94: OE-NIDRR
1990-95: NIH funded RCT Efficacy
1995-00: NIH funded EMG, Kinematics
2002-07: NIH funded RCT Spread of effects
2007-12: NIH funded RCT, imaging
2001-02: Coleman Institute (PDA: LSVTC)
2004-06: NIH LSVTVT (R21)
2002-04: Coleman Institute (VT; LSVTVT)
2004-07: LSVT –Dissemination
2006: Technology-enhanced Clinician Training (SBIR)
2009: Technology-enhanced LSVT LOUD delivery (SBIR)
**Traditional Therapy Approach**

- “Piecemeal approach” targeting multiple impairments unsystematically
- Low to medium intensity
- No treatment of sensory impairments
- Little expectation for lasting improvement
- Compensatory focused

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**Suggested compensatory strategies for rehab**

1. Avoid multitasking during daily activities.
2. Use external cues to initiate and maintain movements during activities.
3. Divide complex movements into a series of simpler components of the overall task, learn to execute sequentially.


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**Our approach**

- Attack underlying mechanism – Early PD
  - Address nigrostriatal deficits
- Also compensatory – Moderate to Late PD
  - Alternative circuits
- Focus on one treatment target: increasing amplitude across motor systems
  - Dual task train
  - Relearn a new internal cue for amplitude scaling
  - Not break systems down, practice with one target
  - Collaborate easily across allied professions
LSVT Programs
Administered in an intensive manner to challenge the impaired system.

Techniques specific to PD-specific deficits! bradykinesia/hypokinesia and kinesthetic awareness (sensory deficit)

LSVT BIG Paradigm Shifts (Covey)

- **TARGET:** Amplitude
- **MODE:** Intensive and High Effort
- Sensory **CALIBRATION:** Generalization

Empowering!

**TARGET**

Loud is more than a laryngeal event — spread of effects

**SOFT**

**LOUD**

**HEALTHY LOUDNESS**
What are the LSVT LOUD exercises?

**Daily tasks**
First half of treatment session
Rescale amplitude of motor output through CORE Loud
- Sustained “ah” (minimum 15 reps)
- High/Low “ah” (minimum 15 reps)
- Functional phrases (minimum 50 reps)

**Hierarchical speech tasks**
Second half of session
Train amplitude from CORE exercises into context specific and variable speaking activities
- Week 1 – words, phrases
- Week 2 – sentences
- Week 3 – reading
- Week 4 – conversation

**MODE**
- Shorter, simple
- Longer, more complex

**CALIBRATION**
MISMATCH between self perception of output and how others perceive it

“I’m not too soft”
“I can’t speak like this, I am shouting!!”

Fox et al, 2002; Sapir et al, 2011

**LSVT LOUD: Data**
Advances in Clinical Efficacy
(Ramig et al., 1995; 1996; 2001a; 2001b; Goetz, 2003)
Cross-system effects, Neural changes

Spielman, Borod (2003) (facial expression)
El-Sharkawi, Logemann (2002) (swallowing)
Ramig & Dromey (1996) (aerodynamics)
P. Fox, Liotti (2003)
Narayana (2010) (PET)
Dromey, (1995) (articulation)
Sapir (2007; 2010) (articulatory acoustics)
Smith, A. (2001) (STI)
Taskoff (2001) (perceptual)
Huber, Stathopoulos, (2003) (respiratory kinematics)

Established Clinical Efficacy
Ramig et al., 2001; JNPP
Level 1 Evidence Goetz, 2003

N=45
Resp & Voice (LSVT LOUD)
Resp

Blinded, no med change
Same time med
Strobe (Smith)
EMG

Imaging Studies with LSVT LOUD
What are the fundamentals of LSVT BIG?

Standardized, research-based, specific protocol

**TARGET:** Bigness (amplitude)

**MODE:** Intensive and High Effort

**CALIBRATION:** Generalization
- Sensory
- Internal cueing
- Neuropsychological changes

**TARGET**

BIG (Large amplitude whole body movement)
Single Target - Triggers Activation across motor systems
**MODE**

Delivery
- Certified LSVT BIG Physical/Occupational Therapist
  - 1:1 intervention

Time of Practice
- 4 consecutive days per week for 4 weeks
- 16 sessions in one month
- 60 minute sessions
- Daily carryover assignments (30 days/entire month)
- Daily homework (30 days/entire month)

**CALIBRATION**

MISMATCH between self perception of output and how others perceive it

“I had no idea how small my world had become”

“I can’t move like this, people will think I am crazy!!”

**PRE-TREATMENT**

Problem in self-perception/awareness - do not recognize movements are small or slow

Self-cueing deficits - continue scaling reduced amplitude of movement patterns

Produce slow, small movements

Reduced amplitude of motor output

Fox et al., 2012
**TREATMENT FOCUS**

- Improve self-perception/awareness of amplitude required to produce normal movement amplitude
- Improve self-cueing/attention to action - habitually scale increased amplitude of movement patterns
- Produce larger movements
- INCREASE amplitude of motor output

Fox et al., 2012

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**Stimulation vs. Training in Therapy**

- **Stimulation** = pt **performs** a task, inducing a transient behavior in response to an external cue
- **Training** = pt participates in a systematic & intensive program designed to change a behavior so that the pt will:
  - develop an internal cue to perform the target behavior & will NOT depend on external cues
  - maintain target behavior over a period of time (i.e. months or years)
- **Training** (and maintaining) requires: **learning**, recall, & ability to internally cue & self-regulation

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**LSVT BIG: Data**
Comparing Exercise in Parkinson's Disease — The Berlin LSVT BIG Study (2010, Movement Disorders) Georg Ebersbach, 1 Almut Ebersbach, 1 Daniela Edler, 1 Olaf Kaufhold, 1 Matthias Kusch, 1 Andreas Kupsch, 2 and Joerg Wissel 3

FIG. 2. UPDRS motor score (blinded rating), mean change from baseline (vertical bars 5 standard deviations). Change between baseline and follow up at week 16 was superior in BIG (interrupted line) compared to WALK (dotted line) and HOME (solid line), P <0.001. ANCOVA did not disclose significant differences between intermediate and final assessments.

Amplitude-oriented exercise in Parkinson’s disease: a randomized study comparing LSVT-BIG and a short training protocol

Georg Ebersbach • Ute Grust • Almut Ebersbach • Brigitte Wegner • Florin Gandor • Andrea A. Kuhn

May 2014

Comparing 4x/week for 4 weeks to 5x/week for 2 weeks

"In spite of comparable outcome of clinician-rated UPDRS scores and laboratory motor assessments, we recommend to deliver LSVT-BIG according to the standard protocol since shorter training routines are less likely to provide patient-perceived improvement." (carryover to functional life)
# LSVT BIG: Treatment Protocol

## Overview – Protocol

- 4 consecutive days a week for 4 weeks
- 16 sessions in 1 month
- 60 minute sessions

## LSVT BIG Treatment Session

### Maximal Daily Exercises
1. Floor to Ceiling – 8 reps
2. Side to Side – 8 each side
3. Forward step – 8 each side
4. Sideways step – 8 each side
5. Backward step – 8 each side
6. Forward Rock and Reach – 10 each side (working up to 20)
7. Sideways Rock and Reach – 10 each side (working up to 20)

### Functional Component Tasks
- **5 EVERYDAY TASKS** – 5 reps each
  - For example:
    - Sit-to-Stand
    - Pulling keys out of pocket
    - Opening cell phone (flip phone)

### Hierarchy Tasks
- Patient identified tasks:
  - Getting out of bed
  - Playing golf
  - In and out of a car
  - Build complexity across 4 weeks of treatment towards long-term goal

### Walking BIG
- Distance/time may vary
Maximum **Sustained** Movements

Floor to Ceiling

Side to Side

Maximum **Sustained** Movements

Floor to Ceiling

Video – Floor to Ceiling

Insert HH DVD clip of this exercise
Maximum Sustained Movements

Video – Side to Side

Multidirectional Repetitive Movements
Step and Reach

Insert HH DVD clip of this exercise

10/6/2014
Multidirectional Repetitive Movements
Step and Reach

Video – Step Forward

Insert HH DVD clip of this exercise

Multidirectional Repetitive Movements
Step and Reach

Sideways Step
Video Step Sideways

Insert HH DVD clip of this exercise

Multidirectional Repetitive Movements
Step and Reach

Video – Step Backward

Insert HH DVD clip of this exercise
Multidirectional **Repetitive** Movements

Rock and Reach

- Forward/Backward Rock and Reach
- Sideways Rock and Reach

Video Forward Rock and Reach

- Insert HH DVD clip of this exercise
Multidirectional Repetitive Movements
Rock and Reach

Video – Sideways Rock and Reach

Insert HH DVD clip of this exercise

Functional Component TASKS

Functional Components – Patient DRIVEN!

• Rolling
• Floor to Stand
• Getting in or out of bed
• Sit to stand
• Sit & reach
• Stand & reach
• Walk & reach
• Walk & turn
• Stand & turn
Video - Sit to Stand

Insert HH DVD clip of this exercise

What about Fine Motor Tasks?

- Even small movements are TOO SMALL in people with PD!
  - Examples: writing, buttoning, teeth brushing, stirring

Buttoning BIG Video

Insert buttoning video
Hierarchy Task Examples

“Real-World” BIG Tasks – Patient DRIVEN!

- In/Out of Car
- Walk and Talk
- ADL’s
- Writing
- Tennis
- Chores
- Golf
- Hiking
- Gardening

Getting in/out of bed
Laundry
Going out to church/restaurant
Playing with children/grandchildren
Shopping
Transportation: train/bus/car
Getting the mail
Cleaning the house

LSVT BIG before and after walking assessments

- Patient 1
  - Before LSVT BIG treatment
  - After LSVT BIG treatment
- Patient 2
  - Before LSVT BIG treatment
  - After LSVT BIG treatment
- Patient 3
  - Before LSVT BIG treatment
  - After LSVT BIG treatment

Generalized Amplitude: Uncued writing post-treatment and untrained during therapy.
LSVT BIG TREATMENT GOAL

People with Parkinson disease will use their bigger movements “automatically” in everyday living – and there will be long-term carryover of increased amplitude use!

Summary

- Advances in neuroscience have provided neurobiological and behavioral evidence supporting the positive impact of exercise-based protocols in people with PD
- There is a rapidly growing literature in physical therapy/exercise protocols in humans with PD
- LSVT Programs have been developed and studied over the past 20 years
- LSVT BIG is one type of therapy program that has potential to offer improvements in movement and quality of life for people with PD

LSVT BIG and LSVT LOUD

- Visit www.lsvtglobal.com to find current LSVT LOUD or LSVT BIG Certified Clinicians
- LSVT Global is happy to partner in hosting a course in your area
- DVDs available to introduce the movement exercises used in LSVT BIG and voice exercises used in LSVT LOUD: www.lsvtglobal.com/products or www.amazon.com/shops/LSVTGlobal