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Application of a Multidisciplinary Approach with Lee Silverman Voice Treatment (LSVT) BIG in the Rehabilitation of an Individual with Parkinson's Disease: A Case Report

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Application of a Multidisciplinary Approach with Lee Silverman Voice Treatment (LSVT) BIG in the Rehabilitation of an Individual with Parkinson's Disease: A Case Report

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Abstract

Background: Parkinson's disease is a progressive, neurodegenerative disorder of the central nervous system and is the most commonly diagnosed movement disorder. It can affect an individual's gait, balance, and quality of life. The purpose of this case report is to outline a multidisciplinary approach to rehabilitation, that incorporates Lee Silverman Voice Treatment (LSVT) BIG, for an individual with Parkinson's disease to address strength, range of motion, fine motor, gait and balance deficits.

Case Description: The patient is a 61-year-old male, who was diagnosed with Parkinson's disease at the age of 56. Secondary to Parkinson's disease, the patient has gross and fine motor impairments that negatively impact his quality of life and independence with activities of daily living (ADL's).

Intervention: Interventions were implemented by an occupational therapist and a physical therapist, both certified in LSVT BIG. The patient attended six, 60-minute treatment sessions with each therapist, for a total of twelve treatment sessions. Each therapist led the patient through the LSVT BIG protocol, and then implemented additional interventions for the remainder of their session based on patient goals and examination findings. Additional interventions included gait, balance, and stair training, sit-to-stands, and specific fine motor tasks which included cutting food, practicing handwriting, donning/doffing clothing, etc.

Outcome Measures: Primary outcome measures utilized by the physical therapist included lower extremity manual muscle testing, cervical range of motion, the Berg Balance Scale, and the Activities-Specific Balance Confidence (ABC) Scale. The occupational therapist utilized grip and pinch strength, the Box and Block Test, and the Nine-Hole Peg Test as primary outcome measures for their treatment interventions. **Discussion:** After 12 sessions, the patient demonstrated improvements in balance, gait, strength, range of motion, and finger dexterity. This case report demonstrates how a multidisciplinary treatment approach for individuals with Parkinson's disease can address multiple facets of the disease, with meaningful improvements in both gross and fine motor function observed.

Background

Parkinson's disease is a progressive, neurodegenerative disorder of the central nervous system. The predominant neuropathological findings are α -synuclein-containing Lewy bodies and loss of dopaminergic neurons in the substantia nigra, a structure of the basal ganglia that resides in the midbrain.²⁶ The basal ganglia is responsible for initiating and controlling patterns of voluntary movements, and with loss of dopamine in the substantia nigra, individuals experience progressive difficulty in the facilitation of voluntary movements, a hallmark feature of this disease. Parkinson's disease affects 1-2 per 1000 individuals.²⁶ Its prevalence increases with increasing age, affecting 1% of those 60 years of age and older, and has a higher prevalence in men.²⁶ The cause of Parkinson's disease is currently unknown, although recent studies have identified several environmental factors that may impact the risk of developing the disease. Genetic factors have also been identified, although 90% of Parkinson's disease cases have no identified genetic component.¹

Parkinson's disease is the most common movement disorder but is characterized by both motor and non-motor symptoms.²⁶ The four cardinal motor symptoms of this disease include bradykinesia, a reduction in the speed and amplitude of movement, muscular rigidity, resting tremor, and postural instability.²⁴ Individuals often develop an abnormally flexed posture originating from the thoracic or lumbar spine, and present with forward flexion of the head and neck, due to a combination of rigidity, dystonia, and impaired proprioception.²⁴ Individuals with Parkinson's disease tend to display a lack of arm swing with ambulation and shuffling gait. They may experience festination, where steps become more rapid and progressively smaller, as well as "freezing" episodes, where the individual has a temporary, and involuntary, inability to move. All of these abnormalities can put the individual at an increased risk for falls. Parkinson's disease affects fine motor skills, for example, manual dexterity, making it difficult for individuals to complete basic activities of daily living such as feeding, dressing, and writing.³ In its early stages, individuals typically experience symptoms on one side of the body only, but with progression of the disease, contralateral symptoms begin to appear.¹

Non-motor symptoms can vary between individuals, and are characterized by sensory symptoms, sleep, cognitive, and psychiatric disturbances, as well as autonomic dysfunction.²⁴ These symptoms often begin years before diagnosis and presentation of motor symptoms. The disease is usually diagnosed with the presentation of the first motor symptoms, which has been estimated to be after 80% of dopaminergic cells in the substantia nigra are already lost.²⁴

Common medical treatment for Parkinson's disease are dopaminergic drugs that attempt to correct motor disturbances. Unfortunately, over time, the majority of individuals respond less to the dosages and experience adverse side-effects that also impact their motor behavior.²⁴ Parkinson's disease severely affects individuals' quality of life, and as it progresses, they often depend on family members or other caregivers for activities of daily living. These individuals tend to require an earlier need for assisted living and have higher hospital admissions compared to the general population.²⁴ However, physical activity and exercise have been shown to improve quality of life and mortality rate in individuals with Parkinson's disease,¹⁴ as well as positively affect both motor and non-motor symptoms associated with this disease.¹⁰

A study performed by Vanbellinghen et al.,²⁷ found that a task-specific home-based dexterity program significantly improved fine motor skills in Parkinson's disease, as compared to upper limb TheraBand exercises for strength. The individuals who specifically practiced precision grip, coordination, and motor sequencing tasks, improved their ability to complete activities of daily living (ADL's). Several studies on Parkinson's disease have placed their focus on gait training, as gait abnormalities are considered hallmark motor symptoms of the disease. Baker et al.² looked at three cueing strategies and their effect on gait variability during single and dual walking tasks. These cueing strategies included external rhythmical auditory cues, verbal instructions to take big steps, and a combination of these two external cues. This study found that gait variability in individuals with Parkinson's disease decreases with external cues, especially with the combination of rhythmical auditory and verbal instruction. The use of external cues in this population has been shown to improve

motor skill acquisition and automaticity of gait and is a common treatment intervention used in rehabilitation facilities for this reason.¹⁸

Another rehabilitation approach, Lee Silverman Voice Treatment (LSVT) BIG, was developed specifically for the Parkinson's disease population. This program is conducted by a certified therapist, and focuses on the amplitude of an individual's movement, for the purpose of achieving bigger, faster, and more precise movements.¹³ Its purpose is to overcome bradykinesia by correcting the individual's perception of their movement amplitude.⁶ It is an intensive program, consisting of sixteen, one-hour sessions over a period of four weeks, and studies have shown that LSVT BIG is effective at improving overall functional mobility, including gait speed, endurance, reaching ability, posture, and balance.⁶ In the recently published JFK BIG study,⁹ LSVT BIG was shown to improve mobility, speed, and performance of both cognitive and motor dual tasks.

There has been and will continue to be research on the benefits of physical activity and exercise for individuals with Parkinson's disease. While many studies outline various methods of intervention, a protocol outlining the most optimal dose, including mode, duration, and frequency of training, does not currently exist. Many studies primarily focus on one discipline of care, and therefore the purpose of this case report is to describe a multidisciplinary approach in the treatment of strength, range of motion, fine motor, gait and balance deficits in an individual with Parkinson's disease, with emphasis on the administration of physical therapy interventions, incorporating the LSVT BIG approach.

Case Description

This patient was chosen due to the multidisciplinary approach provided to him by the clinic in which the patient received treatment. This particular clinic provides neurological rehabilitation and was the primary outpatient site for treating neurological conditions in the area. The patient was chosen due to his age, and stage in the disease process. He was diagnosed with Parkinson's disease at a fairly young age and sought treatment at a point in time where his symptoms were first starting to take a noticeable effect on his daily life.

History

The patient is a 61-year-old male, with a medical diagnosis of Parkinson's disease which primarily affects his left upper and lower extremities. He was diagnosed with Parkinson's disease in 2013 at the age of 56, and his other comorbidities include atrial fibrillation, hypertension, obesity, gastroesophageal reflux disease (GERD), anxiety, hyperthyroidism, and obstructive sleep apnea. This patient also suffers from periodic migraines and has an intracranial arachnoid cyst. His surgical history includes a thyroid ablation, kidney surgery, kidney stone surgery, esophagogastroduodenoscopy, and a cholecystectomy. The dates of these surgical procedures are unknown. The patient's list of medications at the time of his initial evaluation can be found in Table 1.

At the time of his initial evaluations for physical and occupational therapy, the patient's chief complaints included impaired balance, strength and memory, as well as self-care problems and difficulty with activities of daily living (ADL's). He specifically reported having difficulty with driving, cooking, feeding himself, donning/doffing a jacket or coat, completing yard work, manipulating his pills, walking, and safely completing transfers, such as getting into or out of bed, and standing up from or sitting down into a chair. The patient stated that in the few months prior to this evaluation, he had noticed that he was becoming more sedentary, was requiring more time to complete tasks at home and in the community, as well as requiring additional assistance from his partner at home. He had also been experiencing more tremors and fatigue, and although he denied having any recent falls, he reported that he had been tripping often and had come close to falling several times.

At the time of his initial evaluation, the patient was not using an assistive device. He was living in a two-story home, with his partner and two pets, had a tub-shower in his bathroom, and no other home modifications. The patient was working full-time in medical coding, which required him to sit at a desk for the majority of his shifts. The patient's goals for therapy were to increase the range of motion in his arms/neck for driving and completion of daily tasks, to improve the stability of his legs for

transfers and completion of daily tasks with less difficulty, and to improve his gait, balance, confidence, and overall activity tolerance. The patient reported that he had completed the LSVT BIG program a couple of years ago but withstood a meniscus tear in his right knee and had since stopped completing his daily exercises.

Table 1. Medication List at Time of Initial Evaluation.

Name of Medication and Dosage	Purpose of Medication
Amantadine (Symmetrel), 100 mg capsule, 4x/day	Treat symptoms of Parkinson's disease
Aspirin, 81 mg, once daily	Blood thinner, for prevention of DVT/PE
Carbidopa-Levodopa ER (Rytary), 23.75-95 mg capsule, 3 capsules by mouth nightly, 4 capsules 3x/day	Treat symptoms of Parkinson's disease
Cyclobenzaprine (Flexeril), 5 mg tablet, 1 tablet 3x/day as needed	Muscle relaxant
Docusate sodium (Colace), 100 mg capsule, 1 capsule 2x/day as needed	Treat constipation
Fluticasone (Flonase), 50 mcg/act suspension, 2 sprays in each nostril once daily	Treat symptoms of seasonal allergies
Hydrochlorothiazide (Microzide), 12.5 mg capsule, once daily	Treat high blood pressure
Hydrocodone-acetaminophen (Norco), 5-325 mg tablet, 1-2 tablets every 4 hours, as needed	Pain relief (Pain to be rated as 7-10 on Modified Borg Scale)
Lisinopril, 20 mg, once daily	Treat high blood pressure
Multivitamin, 2 tablets daily	
Omeprazole, 40 mg, once daily	Treat gastroesophageal reflux disease (GERD)
Ondansetron (Zofran), 4 mg, every 8 hours, as needed	Treat nausea
DIPL Pain cream (Diclofenac/ibuprofen/pentylene/diglycol/lidocaine in TPC), on painful area 3-4x/day, as needed	Pain relief
Probiotic Product, 1 tablet daily	Promote health of digestive tract and immune system

Synthroid, 150 mg tablet, once daily	Treat hypothyroidism
Tramadol (Ultram), 50 mg tablet, 3x/day, as needed	Pain relief
Triamcinolone (Kenalog) 0.1% Cream, apply to affected area 2x/day, as needed	Treat inflammation from allergic reactions

Examination

This patient was evaluated separately by a physical therapist and an occupational therapist in the same outpatient clinic.

Upon his physical therapy examination, the patient demonstrated decreased step length, trunk rotation and arm swing, as well as reduced gait speed upon an observational gait assessment. He demonstrated impaired lower extremity coordination with alternating toe taps at increasing speeds, and impaired light touch and vibration sense in both right and left feet, with his left foot being more impaired than his right. The patient's lower extremity manual muscle testing can be found in Table 2, and his cervical range of motion can be found in Table 3. Cervical range of motion was measured using a goniometer, which has been shown to be a valid measure of cervical flexion and extension (flexion: $r = 0.97$; extension: $r = 0.98$).²⁵ Upon testing lower extremity reflexes, the patient scored a 1, on a scale of 0-4 for both patellar tendon and achilles reflexes bilaterally, indicating diminished reflexes in bilateral lower extremities.

The physical therapist used the Berg Balance Scale and the Activities-Specific Balance Confidence (ABC) Scale as outcome measures at initial evaluation and reassessment. The Berg Balance Scale is a 14-item objective measure that evaluates static balance and fall risk in the adult population and has been shown to correlate well with overall motor function and state of disease process in individuals with Parkinson's disease.¹⁷ For the Parkinson's disease population, there is high retest reliability (ICC=0.80), and the minimal detectable change (MDC) is 5 points.²⁰ The patient scored a 46 out of 56 on the Berg Balance Scale at initial evaluation, indicating that he was at a 70% risk for falls.²⁰ The Activities-Specific Balance Confidence (ABC) Scale is a 16-item, self-report measure in which patients rate their balance confidence for performing various activities.¹⁹ For the Parkinson's disease population, a score of 69% or lower is predictive of recurrent falls, and the minimal detectable change (MCD) for this population is 11.12%.¹⁹ This questionnaire has shown high correlation with fear of falling in this patient population, and reduced balance confidence has been shown to be associated with recurrent falls.^{7,11} At initial evaluation, the patient scored an 875 out of 1600 on the Activities-Specific Balance Confidence (ABC) Scale indicating 54.5% self-confidence and placing him at an increased risk for falls.

Objective measures completed during the patient's occupational therapy evaluation included sensation, position sense, stereognosis, vibration sense, upper extremity strength, range of motion, grip and pinch strength, coordination, the Box and Block Test, and the Nine-Hole Peg Test. Sensation, position sense, stereognosis, and vibration sense were all intact in the patient's bilateral upper extremities. The patient's upper extremity strength was grossly 4+/5 in all major muscle groups, and his grip and pinch strength at initial evaluation can be found in Table 4. His coordination was unimpaired when tested with "finger to nose" (eyes open and eyes closed) and finger opposition. The patient demonstrated a left-hand tremor at rest.

The occupational therapist utilized the Nine-Hole Peg Test and the Box and Block Test as outcome measures at both initial evaluation and reassessment. The Nine-Hole Peg Test was used to measure the patient's finger dexterity and upper extremity function.²² One study has shown that this test is clinically useful in assessing upper extremity function in individuals with Parkinson's disease, and has a high retest reliability in this population (dominant hand ICC = 0.88, non-dominant ICC = 0.91).⁴

This test requires the patient to pick up and place pegs, one by one from a container, and place them into one of the nine holes on a peg board, and then remove them one by one, as quickly as possible. The minimal detectable change (MDC) for the Parkinson's disease population is 2.6 seconds for the dominant hand, and 1.3 seconds for the non-dominant hand.²² The mean scores for healthy, 61 to 65-year-old males, are 20.87 seconds for the right hand, and 21.60 seconds for the left hand.²² Upon performing this test at initial evaluation, the patient took 34 seconds to complete the task with his right hand (dominant), and 46 seconds to complete it with his left hand (non-dominant), indicating impaired manual dexterity bilaterally. The Box and Block Test was utilized to assess the patient's gross manual dexterity and has been shown to be a good clinical measure of upper extremity function in patients with idiopathic Parkinson's disease.²⁴ This test requires the patient to move 2.5 cm wooden blocks, one by one, from one compartment to another over a partition. The goal is to get as many blocks moved with a time limit of 60 seconds.²¹ The mean scores for healthy, 60 to 64-year-old males, are 71.3 blocks in 60 seconds with the right hand, and 70.5 blocks in 60 seconds with the left hand.²¹ On initial evaluation, the patient was able to transfer 39 blocks in 60 seconds with his right hand, and 33 blocks in 60 seconds with his left hand, indicating poor bilateral gross manual dexterity.

Table 2. Lower Extremity Manual Muscle Testing at Initial Evaluation and Reassessment (After 12 Treatment Sessions).

Lower Extremity Muscle Groups Tested	Strength Score Initial Evaluation	Strength Score Reassessment
Left hip flexors	3-/5	4+/5
Right hip flexors	4+/5	5/5
Left hip abductors	4/5	4+/5
Right hip abductors	5/5	5/5
Left knee flexors	4/5	4+/5
Right knee flexors	4/5	5/5
Left knee extensors	3+/5	4+/5
Right knee extensors	4/5	5/5
Left evertors	5/5	5/5
Right evertors	5/5	5/5
Left inverters	5/5	5/5
Right inverters	5/5	5/5
Left dorsiflexors	5/5	5/5
Right dorsiflexors	5/5	5/5
Left plantarflexors	5/5	5/5

Right plantarflexors	5/5	5/5
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Table 3. Cervical Goniometric Measurements at Initial Evaluation and Reassessment (After 12 Treatment Sessions).

Cervical Motion Tested	Range of Motion Measured in Degrees at Initial Evaluation	Range of Motion Measured in Degrees at Reassessment
Left rotation	35	50
Right rotation	50	50
Left lateral flexion	15	20
Right lateral flexion	15	20
Flexion	Within Normal Limits	Within Normal Limits
Extension	15	30

Table 4. Grip and Pinch Strength at Initial Evaluation and Reassessment (After 12 Treatment Sessions).

	Initial Evaluation		Re-Assessment	
	Right (lbs)	Left (lbs)	Right (lbs)	Left (lbs)
Grasp	78	59	82	71
Lateral pinch	26	21	29	28
3-Point Pinch	13	7	20	18
2-Point Pinch	10	5	11	9

Evaluation

Upon completion of the physical therapy initial evaluation, the physical therapist concluded that the patient demonstrated impairments in gait, lower extremity strength, coordination and sensation, cervical range of motion, and balance, secondary to his diagnosis of Parkinson's disease. The therapist concluded that the above deficits were contributing to the patient's decreased independence with activities of daily living, impaired safety and independence with transfers, impaired social participation, and reduced activity tolerance.

At the completion of the occupational therapy initial evaluation, the occupational therapist concluded that the patient demonstrated impairments in upper extremity, grip, and pinch strength, upper extremity coordination, upper extremity and cervical range of motion, and motor planning, secondary to his diagnosis of Parkinson's disease. This therapist concluded that these deficits were

contributing to the patient's difficulty in reaching overhead, lifting and carrying items in the home, and independence with self-care tasks.

Based upon the patient's history, exam findings, and clinical presentation, both therapists agreed that this patient was an excellent candidate for the Lee Silverman Voice Treatment (LSVT) BIG program, and that he would benefit from both skilled physical and occupational therapy to improve his gross and fine motor skills, in order to address his functional activity and participation limitations.

Intervention

Interventions were implemented by both the occupational therapist and physical therapist, who both held LSVT BIG certifications. Each therapist performed six treatments with the patient. Every session began with the same seven movements as outlined in the LSVT BIG protocol, and the remainder of each session consisted of functional movements and/or specific tasks chosen by the therapist to address patient goals and examination findings. These additional interventions are part of the LSVT BIG protocol, but the choice on what to work on is given to the therapist and tailored specifically to meet the needs of the patient. Treatment sessions were 60 minutes in duration. The physical therapist's treatments focused on gross functional mobility, and the occupational therapist addressed fine motor skills. The patient attended therapy twice a week with the occupational therapist, and twice a week with the physical therapist, for a total of four weeks. This time frame includes each evaluation and reassessment completed by the therapists, therefore the patient participated in twelve total treatment sessions.

LSVT BIG DAILY MOVEMENTS

The LSVT BIG protocol is not well described in freely available or academic sources because the training and certification courses are only offered to physical therapy and occupational therapy professionals, and students.

The LSVT BIG protocol was completed at every treatment session and was led by the therapist. Task One, consisted of two, "Maximum Sustained Movements", in a seated position on a chair that was 19 inches in height. These movements included the floor-to-ceiling and side-to-side exercises, and the patient performed six repetitions of each (bilaterally if appropriate).

Task Two, consisted of five, "Repetitive/Directional Movements", in standing. Three step and reach exercises, including forward-reach and back, sideways-reach to side, and backwards-reach down and back, were each performed six times (bilaterally if appropriate). And, two rock and reach exercises, the sideways-reach and twist and forwards/backwards-reach up and back were performed. Six repetitions of sideways-reach and twist were performed bilaterally, and ten repetitions of forwards/backwards-reach up and back were performed bilaterally.

Movements performed within this protocol addressed mobility deficits common in individuals with Parkinson's disease. Every movement required opening up and lifting the trunk and limbs against gravity, working to counteract the flexed posture typical of individuals with Parkinson's disease. Movements that involved a weight shift, worked on improving the individual's ability to walk, turn, stop, or complete transfers. The inability to shift body weight in different directions can contribute to "freezing" gait and falls. Movements that involved twisting worked to reduce rigidity and make activities of daily living easier to perform (rolling, getting out of bed, getting into a car, checking a blind spot while driving, etc.). And movements requiring a "step", required unweighting and transitioning of a limb, to improve ambulation, strength, transfers, while also reducing shuffling gait and improving balance.

Summary of Occupational Therapy Sessions

Excluding initial evaluation and reassessment, the patient attended six treatment sessions with the occupational therapist. The therapist led the patient through each of the seven LSVT BIG movements, encouraging the patient to produce "big" movements with both his upper and lower extremities by giving him both visual and verbal cues, and to count out loud to promote a "big and loud" voice, as Parkinson's disease can affect an individual's oral motor skills, leading to quiet and hurried

speech.²⁴ The exercises were always performed in the same order, with Task One, seated exercises performed first, and Task Two, standing exercises, performed afterwards. In between each exercise, the patient ambulated 90 feet to “check-off” the exercise he had just completed and was given visual demonstration and verbal instructions/cues to increase his stride length and complete large-amplitude, reciprocal arm swings. The remainder of each hour-long session was dedicated to working on the patient's gait, stair training, sit-to-stand transfers, and fine motor tasks. Fine motor tasks completed throughout the six treatment sessions included manipulating chip clips, zip-lock bags, opening condiment packets, donning/doffing shoes, practicing handwriting, and cutting up food.

Physical Therapy Sessions

Each physical therapy treatment session began with Task One and Task Two Movements per LSVT BIG protocol, as described above. The physical therapist utilized cueing strategies similar to those used by the occupational therapist, and also worked on ambulation in between each exercise. The remainder of each hour-long session, consisted of gait and stair training, sit-to-stand transfers, or balance tasks. Six one-hour treatment sessions were completed with the physical therapist over the four weeks. Each treatment session will be described in more detail in the upcoming sections.

Week 1 - Treatment Session 1

The first treatment session was held over a month after the initial evaluations completed by the physical and occupational therapists. In this time between sessions, the patient received surgery for placement of a Duopa pump. This pump consists of a carbidopa/levodopa enteral suspension which is administered at a constant rate throughout the day through a pump via a PEG-J tube.¹⁶

The patient completed Task One and Task Two movements at the beginning of the session. With Task One movements, in a seated position, the patient was given verbal cues and visual demonstration to make his upper extremity movements symmetrical, as his left side displayed a tendency to produce smaller movements compared to his right. The patient was also instructed to look at a focal point on the wall to promote increased neck and trunk rotation with reaching and twisting movements. With Task Two movements, the patient was given verbal cues and visual demonstration to increase shoulder abduction, flexion, and extension with each movement to promote larger amplitude movements, increased range of motion, and improved posture, and was instructed to look at a focal point on the wall to promote increased trunk and neck rotation. Due to loss of balance, the patient was also instructed to reduce his forward and backward step length with the step and reach exercise, and the backwards-reach down and back exercise.

The remainder of the session focused on “Functional Component Movements”. The patient completed six, sit-to-stand transfers from a lowered mat table (20 inches high), with verbal cues to reach out “big” and finish “big”. The therapist instructed the patient to bring his arms out forward as he initiated standing, and to abduct them as he completed his transition to a full standing position to promote appropriate forward weight shift and open posture. The patient was also given verbal prompts to control his descent back into the chair, in order to work on eccentric strength and control, as well as safety with transfers.

Week 2- Treatment Sessions 2 & 3

Task One and Task Two movements were completed at the beginning of each session. The patient was instructed throughout the series of exercises to make his arm movements symmetrical, to correct his posture, to count louder, and to reach further and shift his weight further forward or sideways during reaching movements. He was again instructed to look at a focal point on the wall during sideways and twisting movements to promote increased neck and trunk rotation. When completing the 90 feet of walking in between each exercise, he was given verbal cues to look up, instead of down at his feet, and to increase his arm swing.

Session 2 focused on sit-to-stand transfers and gait. The patient completed six sit-to-stand transfers from a lowered mat table (20 inches high), was again given cues to reach out “big” and finish

“big”, and to eccentrically control his movement back into sitting. During gait training, the patient completed 1 lap of walking around the clinic, approximately 185 feet. He was consistently given cues to increase his step length and increase the amplitude of his arm swing bilaterally. He was also given instructions to maintain upright posture.

Session 3 emphasized sit-to-stand transfers, stair and gait training. The patient was given verbal and visual instructions to increase forward trunk flexion during six repetitions of sit-to-stands, to promote forward weight shift and make the transition from sitting to standing easier. He ascended and descended 22 steps to work on step amplitude, and to address strength and endurance deficits. He then ambulated throughout the gym areas, approximately 200 feet total, around various obstacles and corners, and was given intermittent physical assistance to increase his arm swing. Obstacles and corners were integrated into walking to simulate real-life environments, and to challenge the patient's balance, ability to weight-shift and change directions.

Week 3- Treatment Sessions 4 & 5

The therapist led the patient through Task One and Task Two movements at the beginning of each session, with similar verbal and visual cues as in previous sessions.

Session 4 focused on sit-to-stand transfers, stair and gait training. The therapist progressed sit-to-stand transfers this session from a 15-inch box, with cues to increase forward trunk flexion to promote forward weight shift before transitioning to standing, and again cued the patient to reach “big” and finish “big” and to control his descent back into the chair to work on eccentric quadriceps strengthening and safe transfer skills. The patient ascended and descended 22 steps to work on step amplitude, strength, and endurance, and was given instructions to increase his speed with this activity this session. He then ambulated four laps around the clinic, with verbal instructions to increase his arm swing bilaterally, and to take larger steps, with emphasis on heel strike to promote quality of gait and reduce tripping hazard.

Session 5 focused on sit-to-stand transfers, stair and gait training as well, with similar verbal and visual cues as in previous sessions. In addition, the therapist incorporated a balance component. The patient completed four laps, down and back, of tandem walking on an Airex balance beam. This exercise not only challenged his balance with a narrowed base of support and a dynamic surface, but the tandem walking also challenged his lower extremity coordination.

Week 4- Treatment Session 6

Only one treatment session was completed during week four. Task One and Task Two movements were completed at the beginning of the session, with similar verbal and visual cues from previous sessions.

Session 6 incorporated sit-to-stand transfers, balance and gait training. To further challenge the patient with sit-to-stands, the therapist instructed the patient to place his feet on a small wedge, so that his feet were at an incline when standing up. The wedge provided another dynamic and uneven surface that the patient had to accommodate for, and it forced the patient to increase his forward weight shift so that the wedge could not force his body backwards upon standing. Similar cues were given as in previous sessions, and appropriate assistance was provided for patient safety. The patient completed four laps of tandem walking, down and back, on an Airex balance beam to challenge balance and coordination, and then the patient completed two laps of walking throughout the clinic with emphasis on exaggerated stride length and bilateral arm swing.

Home Exercise Program

Per LSVT BIG protocol, the patient was instructed to complete Task One and Task Two movements twice a day. On days he attended therapy sessions, he was to complete the protocol only once on his own. The patient was also instructed to practice walking with exaggerated stride length and arm swing on his own, for 10-15 minutes a day.

Outcome Measures at Reassessment

As treatment progressed, the patient demonstrated improvement in his performance with Task One and Task Two movements. He required less verbal cueing and visual demonstration from both therapists, and demonstrated improved posture, more symmetrical arm movements, improved weight shift, increased trunk and neck rotation, as well as improved activity tolerance overall. At reassessment, the patient reported that he felt he had made improvements in his strength, balance, trunk rotation, and endurance from the time of his initial evaluation. He reported that turning to look over his shoulder while driving was easier to do, and he stated that his confidence had increased significantly, along with his mood and motivation to be active.

Upon formal objective assessment, the patient demonstrated overall improvement in lower extremity strength, as well as cervical range of motion in all directions he was initially limited in, which were cervical rotation, lateral flexion, and extension. The patient's lower extremity manual muscle testing scores and cervical range of motion measures at reassessment can be found in Table 2. Upon observation, the patient also demonstrated improvements in quality of gait, as noted by improved reciprocal arm swing, cadence, and increased step length. The patient tested the same at reassessment for lower extremity reflexes, coordination, and sensation.

At reassessment, the patient scored a 52 out of 56 on the Berg Balance Scale, placing him at a 25% risk of falls (initial evaluation 46 out of 56 (70% fall risk)).²⁰ From initial evaluation, the patient improved his score by 6 points, and reduced his risk of falling by 45%. With an MDC of 5 points for the Parkinson's disease population,²⁰ the patient demonstrated a meaningful improvement in his balance over the four weeks of treatment. The patient scored a 1365 out of 1600, or 85%, on the Activities-specific Balance Confidence (ABC) Scale at reassessment (initial evaluation, 875 out of 1600 (54.7%)), increasing his confidence with performing various activities of daily living by approximately 30%. The MDC for the Parkinson's disease population for this self-reported questionnaire is 11.12%.¹⁹ Therefore, the patient demonstrated a meaningful change in his confidence with performance of activities from initial evaluation and reduced his overall risk of falls (score >70%).¹⁹

Upon reassessment with the occupational therapist, the patient reported that his self-care tasks, including showering, dressing, grooming, toileting, and feeding had become easier to complete, and that from initial evaluation, it took him 10 less minutes to get ready in the morning, which was considered an important change to him. He reported that manipulating silverware, cutting his food, and manipulating his pills were specific tasks that he had noticed had become much easier for him over the four weeks of treatment.

With formal objective testing, the patient demonstrated improvement in active neck rotation (Table 3) and grip and pinch strength (Table 4). His coordination, sensation, and gross upper extremity strength remained the same. On the Nine-Hole Peg Test, the patient decreased his score to 22 seconds with his right hand (34 seconds at initial evaluation), and to 23 seconds with his left hand (46 at initial evaluation). The minimal detectable change (MDC) for the Parkinson's disease population is 2.6 seconds for the dominant hand, and 1.3 seconds for non-dominant hand.²² The patient demonstrated a 12 second improvement on his dominant (right) hand, and a 23 second improvement on his left (non-dominant) hand, indicating an improvement in finger dexterity far exceeding the MDC from initial evaluation.²² Upon completion of the Box and Block Test, the patient was able to move 57 blocks with his right hand (37 at initial evaluation), and 52 blocks in 60 seconds with his left hand (33 at initial evaluation), indicating a meaningful improvement in upper extremity function from initial evaluation.²¹

Discussion

The purpose of this case report was to outline a multidisciplinary approach in the rehabilitation of an individual with Parkinson's disease, and to evaluate the patient's response to the interventions. The primary intervention was the Lee Silverman Voice Treatment (LSVT) BIG protocol, which was administered by an occupational therapist and a physical therapist throughout the course of treatment. In compliance with the LSVT BIG protocol, the therapists implemented various interventions to address

the patient's fine motor and gross functional mobility deficits as identified at initial evaluation. The treatment strategies were aimed at improving the patient's posture, gait, strength, balance, and ability to complete safe transfers, as well as his upper extremity strength and hand/finger dexterity to improve his ability to complete self-care tasks.

The patient was selected upon initial evaluation as a good candidate for the LSVT BIG protocol based on his current impairments, activity and participation limitations, as well as his young age, ability, and willingness to participate in an intensive program. LSVT BIG is a program that requires high effort from the patient. This treatment approach aims to "normalize" movement by emphasizing "bigger" amplitudes of limb and body movement.⁶ As the disease progresses, patients with Parkinson's disease develop slow, hesitant, and small amplitude movements (bradykinesia, akinesia, and hypokinesia), and by emphasizing larger movement patterns, LSVT BIG aims to re-calibrate the patient's perception of movement execution.⁶ Several studies have shown that gait speed, speed and performance of cognitive and motor dual tasks, as well as overall motor function as defined by the Unified Parkinson's Disease Rating Scale (UPDRS), improves in individuals with Parkinson's disease who participate in the LSVT BIG program.^{9,13}

The patient also participated in gait training, gross functional mobility skills, and balance training. The patient was given external cueing for more improved cadence, as well as for larger amplitude step length and arm swing. External cues that give temporal or spatial stimuli associated with gait, have been shown to improve gait variability in individuals with Parkinson's disease.² The therapist addressed balance with the movements in the LSVT BIG protocol, by having him reach and step out of his base of support. The patient also worked on balance with narrowed base of support on a dynamic surface, which has been shown to improve both static and dynamic balance through activation of vestibular and visual systems, strengthening of ankle musculature and training of postural corrections.¹⁵ Little research has been conducted on the effect of LSVT BIG on individuals' balance. But one study, by Millage B et al.,¹⁴ demonstrated that four out of nine participants with Stage 1 Parkinson's disease who participated in LSVT BIG treatment 4 times a week for four weeks, met the MCID required improvement in performance on the Berg Balance Assessment immediately following completion of the protocol, and again at 3 months follow up. Four of the five participants who did not demonstrate improvement, had a baseline score that was so high that the achievement of improvement at a level of the MCID was not possible.

Unique to this case report, is that the patient also participated in occupational therapy to address fine motor skills related to self-care tasks during his four weeks of treatment. While there is currently a lack of research to support improvement in fine motor skills from participation in the LSVT BIG protocol, a couple of studies have shown that programs addressing manual dexterity have shown to improve fine motor skills in individuals with Parkinson's disease by addressing precision grip, coordination, and motor sequencing tasks.^{12,27}

The patient demonstrated measurable improvements in lower extremity strength, balance, cervical range of motion, and manual dexterity as measured by formal manual muscle testing, goniometric measures, the Berg Balance Scale, and the Nine-Hole Peg Test and Box and Block Test. Improvements observed over the four weeks of treatment by the experienced and licensed therapists, include improvements in gait quality and posture. The patient also subjectively reported significant improvements in his overall quality of life and confidence in completion of various activities of daily living. These measures demonstrate that the patient made meaningful improvements in both gross motor and fine motor skills over his four weeks of treatment, creating a positive impact on his quality of life and daily function. The multidisciplinary approach to treatment enabled the patient to make functional gains in various facets of his overall physical functioning.

Factors that may have positively influenced patient outcomes outside of treatment include patient compliance with his home exercise program, and a change in the patient's Parkinson's disease medication from initial evaluation. The patient completed the LSVT BIG protocol twice a day, on most days, and worked on exaggerated step length and arm swing while walking with a co-worker for 20 minutes every day on his lunch break. After his initial evaluations, but before starting physical and

occupational therapy treatment, the patient began using a Duopa pump, which consists of a carbidopa/levodopa enteral suspension, which has recently been approved by the USA Food and Drug Administration (FDA) for the treatment of advanced Parkinson's disease patients.¹⁶ This drug is administered at a constant rate throughout the day through a pump via a PEG-J tube that is surgically implanted. More research is needed to examine the effectiveness of this drug on the patient population, but the efficacy of Duopa was established based on a study that demonstrated that the average "off" time in those with Parkinson's disease was reduced by 4 hours, as compared to 1.9 hours with oral immediate release carbidopa/levodopa.¹⁶ The introduction of this pump before treatment intervention could have contributed to overall improvements measured at reassessment.

A limitation of this case report is the lack of appropriate outcome measures. The patient subjectively reported gait impairments at initial evaluation, and upon observational gait assessment, the therapists also listed it as an impairment and created functional goals to assess and address gait quality throughout treatment. Although in the initial plan, the patient never performed a Six-Minute Walk Test (6MWT) or a Timed-Up and Go (TUG) assessment, which are two popular outcome measures to assess walking endurance and gait speed. Therefore, at reassessment, improvements in gait could not be quantified, but only spoken to from an observational analysis by both the occupational and physical therapist. Another functional activity addressed throughout the patient's course of treatment was sit-to-stand transfers, but no functional outcome measure was used to measure improvement with this task. A simple Five Times Sit to Stand Test could have been implemented to measure improvement in the patient's lower extremity strength and endurance over time. Several research studies on interventions for Parkinson's disease also utilize the Unified Parkinson's Disease Rating Scale (UPDRS), a comprehensive assessment of the extent of Parkinson's disease and its effect on various dimensions of the patient's life across the course of the disease.²³ It serves as a way to provide a clinical endpoint in therapy treatment, and consists of four parts: non-motor experiences, motor experiences, motor examination, and motor complications.²³ Because most studies evaluating treatment outcomes in Parkinson's disease, including the Berlin LSVT BIG study,⁵ utilize this outcome measure heavily, we are unable to compare the treatment effects outlined in this case report to other prominent research studies addressing similar deficits in this patient population.

Conclusion

In conclusion, this case report outlines a multidisciplinary approach to rehabilitation in a patient with Parkinson's disease. The outcomes of this treatment support the use of both fine motor and gross motor training to improve various components of an individual's physical function. More research is warranted at this time in regard to manual dexterity training in individuals with Parkinson's disease, as well as the impact that LSVT BIG has on improving static and dynamic balance.

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