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Utilizing PWR!Moves® and Gait Training for a Patient with Parkinson's Disease: A Case Report

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Abstract

Background: Parkinson's disease (PD) is a progressive neurodegenerative disease that affects 7-10 million people worldwide. It is the second most common neurodegenerative disease behind Azheimers and is expected to grow 4-fold by the year 2040. Patients with PD can experience a myriad of motor symptoms including resting tremors, bradykinesia, rigidity, postural instability, altered gait patterns, freezing of gait, and balance/coordination impairments. **Case Description:** The patient is a 69 year-old male presenting to the outpatient orthopedic clinic with a referral from a local neurologist to evaluate and treat with a diagonosis of Parkinson's disease. His primary complaints were that he has poor balance, cognitive decline, and that he moves very slowly with a shuffling pattern. The patient's desired goals are to reduce his fall risk and improve his walking velocity, so that he can be more independent and safe in the community **Intervention:** The patient completed 9 therapy sessions consisting of some form of gait training and PWR!Moves. The PWR!Moves program was focused on high amplitude and maximum effort moves that were implemented in 5 different positions that concentrated on 4 specific skills including antigravity extension, weight shifting, axial mobility, and transitional movements in order to improve the symptoms associated with PD. **Outcome Measures:** The Berg Balance Scale was used to assess the patient before and after the intervention. The patient also self-reported many noticeable improvements following the treatment intervention. **Discussion:** The purpose of this case report was to present a treatment approach consisting of gait training and PWR!Moves for a patient with PD in an outpatient orthopedic setting. Similar to results reported in the literature regarding high amplitude movement interventions, the patient in this case report significantly improved his Berg Balance Scale score and demonstrated an improved gait pattern at his last physical therapy visit.

Keywords: Parkinson's Disease; neurology; gait training; physical therapy; rehabilitation

Background

Parkinson's Disease (PD) is a progressive neurodegenerative disease that can be defined by both motor and nonmotor symptoms. The term Parkinson's Disease was first expressed by Dr. James Parkinson back in 1817 as a "shaking palsy" and since then it has become a very common disease in today's society and is affecting 7-10 million people worldwide according to the Parkinson's Disease Foundation.[5,13] Parkinson's Disease is the second most common neurodegenerative disease behind Alzheimer's Disease.[1] It is estimated that the PD population will grow 4-fold by the year 2040.[8] PD is more common in males than females with a ratio of 3:2 and tends to have a delayed onset in females due to the neuroprotective effects of estrogen. The mean age of PD onset is 60 years old, but it can be developed in people in their 30s and 40s with the probability increasing as people age.[5]

PD is a disorder of the extrapyramidal system which includes the motor structures of the basal ganglia. The degeneration of striatal dopaminergic and nondopaminergic neurons affect the motor and nonmotor symptoms and impact the clinical features associated with Parkinson's Disease.[5] Patients with PD can experience a myriad of motor symptoms caused by the impaired dopaminergic pathways including resting tremors, bradykinesia, rigidity, postural instability, altered gait patterns, freezing of gait, and balance/coordination impairments. It is important to note that nonmotor symptoms may develop several years prior to motor symptoms developing. These may include cognitive impairments, psychological impairments, sleep disorders, pain, and fatigue. Research shows that there is a very high variability among PD patient's symptoms and the rate of disease progression. The therapist was able to witness this at the clinical site, as there were many different presentations of Parkinson's Disease. One patient may have had only a few motor symptoms while others demonstrated motor and nonmotor symptoms. The combination of PD symptoms may differ, but functional capacities, activities of daily living, social participation, and ultimately quality of life can all be negatively affected by Parkinson's disease in similar ways.[11,13]

There is still no definitive test to diagnose PD and diagnosis can become very difficult for physicians to make depending on patient presentation. Diagnosis of PD can be made based off of dopaminergic neuron loss in substantia nigra pars compacta and the presence of intraneuronal Lewy bodies. A holistic approach to diagnosing PD is helpful to increasing diagnostic accuracy. This involves a thorough history taking, comprehensive and systematic clinical examination, and ability to recognize inclusion and exclusion criteria. The most common clinical presentation leading to a diagnosis can include symptoms of bradykinesia, rigidity, and resting tremor.[12,15]

Undoubtingly, the previously mentioned motor and nonmotor symptoms associated with PD can have a dramatic impact on one's motor function, cognitive health, and quality of life. Numerous research studies have strengthened the idea that exercise interventions of progressive resistance training, treadmill training, Tai Chi, and PD-specific programs are associated with promoting many health benefits in patients with Parkinson's Disease. However, the interventions in these studies tended to be less than 6 months duration and did not focus on long-term benfits. A longitudinal analysis of the National Parkinson Foundation Quality Improvement Initiative examined whether exercise had an impact on changes in health-related quality of life (HRQL) and mobility in patients with advanced PD over a two year period. The group revealed that regular exercise was associated with significant positive effects on HRGL and functional mobility changes over a two year period.[20] PD exercise programs have also been found to demonstrate improvements in cognitive function. A systematic review of 9 randomized control trials (RCT) of PD patients at mild to moderate stage found that physical exercise interventions encourage positive and noteworthy "effects on global cognitive function, processing speed, and sustained attention and mental flexibility in Parkinson's disease patients." They claimed that treadmill training produced the largest improvements in cognition.[4]

Developments in neuroscience research support the idea that exercise "acts at the molecular level to inhibit cell death, increase synaptic efficiency, and promote behavioral recovery in animal models (rodents) of Parkinson's disease."[5] Research has recognized that voluntary exercise, treadmill training, skills training, and forced limb use can encourage brain neuroplasticity in rodent models with PD and in humans with neurological impairments such as stroke and spinal cord injuries. Upregulation

of various trophic factors such as Glial Cell Derived Neurotrophic Factor (GDNF), Fibroblast Growth Factor 2 (FGF-2), and Brain Derived Neurotrophic Factor (BDNF) through exercise can prime the brain to be more adaptable and potentially support a neuroprotective effect.[7] Research conducted by Smith and Zigmond (2003) explored into the neuroprotective effects of motor exercise on dopamine neurons in rodents. It was found that forced exercise can reduce the susceptibility of dopamine neurons to 6-hydroxydopamine which normally destroys these neurons. They also reported that the trophic factor GDNF was upregulated which could also influence neuroprotective effects.[22]

Gait training has shown to not only produce improvements in cognition but also motor abilities. Picelli et al. (2016) evaluated the effects of treadmill training on both congniton and motor features in patients with mild to moderate PD. Patients participated in treadmill training three days a week for 45 minutes each day for 1 month. The group found that participants' Fronal Assessment Battery(FAB) and 6 Minute Walk Test (6MWT) significantly improved in the treatment group following the intervention. This study was limited by the enrollment of only 17 participants.[18]

Cuing strategies have been shown to be effective at improving gait in PD patients. It is argued that cuing infomation can bypass the impaired basal ganglia and use different pathways to improve motor performance. The use of attentional and rhythmic auditory cues during gait training has been demonstrated by Baker et al. (2007) to be an effective strategy at increasing gait speed and step amplitude during single and dual tasks. The attention strategy had participants focus on taking bigger steps while the auditory cues focusd on walking to a metronome beat. The attention strategy and the combination of both strategies showed equally effective significant improvements while the metronome alone did not demonstrate significant improvements. These strategies can offer functional treatment options for gait deficits in PD and can be utilized when there are issues with increased attentional demand and impaired cognitive functioning.[2]

Dr. Becky Farley is the founder of Lee Silverman Voice Treatment (LSVT) BIG which she developed prior to designing an updated version of the PD-specific program by the name of Parkinson Wellness Recovery program (PWR!Moves®), which aims at helping with Parkinson's disease delay, decreasing fall risk, improving quality of life, and improving real world function. The PWR!Moves framework is based on clinical research in exercise science, motor control, motor learning, and clinical experience in order to optimize brain health, learning, and function. She addresses both motor and non-motor symptoms in her program. The PWR!Moves program is designed to teach high intensity efforts, cognitive engagement, attentional focus, and reinforcement/feedback for positive behaviors. Dr. Farley's program consists of many different moves that are implemented in different positions that focus on 4 specific skills including antigravity extension, weight shifting, axial mobility, and transitional movements in order to improve the symptoms associated with PD (Figure 1).[10] One of the main focuses of the program is to teach high amplitude, maximum effort whole body movments in order to reduce the symptoms associated with PD. Studies support the effectiveness of rehabilitation strategies focusing on high amplitude maximum effort PD-specific movements. These studies will be discussed later in the paper.

There has been a lot of research conducted explaining how exercise can be beneficial to patients with neurological disorders, but there is no current protocol or gold standard of care for patients with Parkinson's disease. The purpose of this case report is to present a treatment approach consisting of gait training and PWR!Moves for a patient with PD in an outpatient orthopedic setting.

Case Description

History

The patient is a 69 year-old white male who presented to the outpatient orthopedic clinic with a referral from a local neurologist to evaluate and treat with a diagonosis of Parkinson's disease. He was diagnosed 2 weeks prior to his initial physical therapy examination, but he had experienced his symptoms for about a year prior to his neurologist visit. The patient had not received any physical therapy services for Parkinson's disease prior to his visit. His primary complaints were that he had poor

balance and that he moved very slowly with a shuffling pattern. He reported that his feet were not able to move fast enough to catch himself when he loses his blance. The patient reported that these symptoms have influenced 4 falls in the last 3 weeks. The patient also noted that he has experienced some cognitive decline over the last few months and that he cannot think and reason as quiclkly as he has in the past. He lives at home with his wife and ambulates without any assistive device. The patient enjoyed the outdoors and being active, but was limited in his activity level due to his symptoms and apprehension about falling. His past medical history and co-morbidities include: anxiety, depression, benign prostatic hyperplasia, carotid athlerosclerosis, bilateral carpal tunnel syndrome, corornary artery disease, dysphagia, hypertension, and resting tremors. His desired goals were to reduce his fall risk and improve his walking velocity, so that he could be more independent and safe in the community.

Examination

Patient presented to physical therapy with a mildly flat affect. He had a kyphotic posture and demonstrated forward head rounded shoulders while upright and sitting. His lower extremity range of motion was grossly within functional limits and his lower extremity strength was grossly 5/5. Patient did demonstate reduced trunk flexibility and had reduced range of motion in all directions. He was able to roll into a prone on elbows postion, move into quadruped position, tall kneel, and half kneel positions bilaterally and independently but with decreased movement speed. The patient was also able to perform sit-to-stand transfers independently without the use of his upper extremities. His gait was assessed in the hallway without the use of an assistive device. The patient demonstrated a slow, shuffling gait pattern with mild to moderate path deviation and had little to no arm swing bilaterally. The patient completed the Berg Balance Scale (BBS) which is a test that evaluates 14 different criteria including reaching, bending, transferring, and standing activities to assess a patient's static and dynamic balance abilities and to predict fall risk. A study looking at minimal detectable change (MDC) in patient's with Parkinson's disease found that the Berg Balance Scale had a MDC of 5 that was calculated using a 95% confidence interval.[23] The BBS score has been shown to have significant correlations with motor functioning indicators, stage of the disease, and daily living capacity. In each of these correlations, patients with lower scores on the BBS had higher scores on the Unified Parkinson's Disease Rating Scale which indicates greater motor impairments.[19] The BBS has been shown to have excellent test-retest reliability with an intraclass correlation coefficient (ICC=.94), intrarater reliability (ICC=.95), and interrater reliability (ICC=.84).[21] Although the patient had reported multiple falls over the past few weeks, he had an overall BBS score of 50/56 which placed him at midrange in the low fall risk category suggesting that other factors may have been influencing his fall risk that are not measured with the BBS.

The patient did not show any significant balance impairments throughout the initial examination and scored relatively high on his Berg Balance Scale assessment, but his bradykinesia significantly impacted his functional independence, reactive balance control, and quality of life. The patient was chosen for this case study because of the unique treatment approach of PWR!Moves that was implemented in his plan of care which focus on high amplitude, maximum effort movement patterns in order to foster improvement of the patient's primary impairments. The clinical setting was also unique in the fact that it is rare to have patients with PD present to an outpatient orthopedic clinic.

Clinical Impression

The Berg Balance Scale revealed deficits in the patient's ability to perform dynamic balance activities safely. The patient had difficulty with reaching forward, looking over his shoulders, turning in a full circle, standing tandem, and standing on one leg. His bradykinesia during gait and functional tasks increased his fall risk and limited his functional independence, but as previously mentioned it did not directly affect his Berg Balance Scale score. His cognitive function was not objectively assessed, but the patient stated that this also reduced his ability to function at his normal capacity.

Upon completion of the initial evaluation it was deemed that the patient is an appropriate candidate for an intervention consisting of gait training and PWR!Moves due to the research that

supports it and the patient's clinical presentation. Research has shown that gait training can positively influence gait speed, step amplitude, and cognition.[2,18] Similarly, interventions focusing on large amplitude whole body movements can result in improved speed-amplitude scaling relations within the upper and lower extremities.[9] It has been supported that training high amplitude big movments can improve motor performance scores including the Berg, Timed-up-and-go test, Functional Gait Assessment, and 5x Sit-to-Stand.[3,6,9,16] It was hypothesized that the patient would benfit from an intervention consisting of gait training and PWR!Moves based on research and the patient's clinical presentation in order to minimize his PD symptoms, improve his cognitive function, reduce his fall risk, and improve his quality of life.

Intervention

Treatment Session 1

The initial goal of the first 40 minute therapy session was to have the patient work through all of the 4 basic PWR!Moves in all 5 positions shown in (Figure 1) to begin focusing on posture, weight shifting, trunk flexibility, and stepping magnitude. The therapist wanted to evaluate his ability to complete each exercise with proper technique and safety. The patient was provided cuing throughout the session to complete each exercise with proper technique, high magnitude, and maximum effort. The therapist also educated the patient on how each of the exercises applied to real world function and how they can help him reach his goals. The patient demonstrated good tolerance and safety with all PWR!Moves in prone, supine, and sitting but required stand-by-assist for all of the moves while standing. He was very motivated to exercise at home and he requested PWR!Moves in supine, prone, quadruped, and seated positions to complete as a home exercise program. The sit-to-stand PWR! Up and the standing exercises were not provided due to his increased fall risk.

Figure 1. The 4 different PWR!Moves shown in the 5 different positions. **PWR! Up** targeting posture. **PWR! Rock** targeting weight shift. **PWR! Twist** targeting trunk rotation. **PWR! Step** targeting transitional movements. Figure reproduced from Dr. Becky Farley's presentation materials, with written permission from Dr. Farley.

The remaining time of the first therapy session was focused on gait training in the hallway. The patient had bradykinesia and very small step lengths, so he was provided with repetitive attentional cues to take big steps. The patient also had little to no arm swing so he was cued to exaggerate his arm swing to improve his gait efficiency. The patient completed multiple laps in the hallway focusing on these attentional cues and no other external cues were provided to prevent cognitive overload. Focusing on cadence and increasing velocity was addressed in later therapy sessions. The patient ended up going on a vacation the following day after this session and returned two weeks later.

Treatment Session 2

Upon arrival after being on vaction for two weeks, the patient reported that he had been very consistent with his PWR!Moves home exercise program. He also noted that he had not experienced any falls since his initial therapy visit, but he did admit to some “close calls.”

The primary goals of this therapy session were to review all of the home exercises to ensure proper technique and to begin PWR!Moves in standing. The patient received a moderate amount of cuing for technique, hand placement, speed of movment, and magnitude of movment during the home exercise program review. He demonstrated good performance of the PWR! Moves in supine, prone, quadruped, and sitting after cuing and repetitions, and he had a good understanding of the goals and functional applications of each move (Figure 1).

The patient still demonstrated a slow shuffling gait with limited arm swing in his gait pattern. During this session he completed a brief gait training session in the hallway focusing on arm swing and taking bigger steps. The first new exercise the patient completed was repetitive sit-to-stand transfers focusing on high amplitude and maximum effort. He was cued to try not to use his hands to push off his chair and to open his arms up as wide as he could as he stood up. The patient also completed PWR! Twists in standing with a wide base of support, which involved the patient rotating his shoulder, trunk, and hips so that he could clap his hands together. He was then instructed to open up both arms fully and then twist to the contralateral side to clap. The emphasis of this exercise was also maximum effort and it focused on trunk rotation, weight shifting, and balance. PWR! Rocks were completed in standing with the patient facing a wall with sticky notes at different heights. He was instructed to shift his weight to each side while reaching ipsilaterally as far as he could to the target sticky notes. Again, balance and weight shifting was the major focus with this exercise. PWR! Steps were completed in standing with two colored circular targets 2 feet in front of each of the patient’s feet. He was instructed to take big steps to each target while alternating feet. The therapist used a metronome to help speed up the patient’s step cadence. This exercise was utilized to begin to target the patient’s symptoms of bradykinesia with gait.

Figure 2. PWR! Steps with the addition of sport cord resistance.

Figure 3. PWR! Steps over two stairs focusing on high amplitude movement.

Treatment Sessions 3 and 4

The patient reported that he has been focusing on picking up his feet more at home, especially with stairs. Therapy sessions 3 and 4 are grouped together because the patient completed very similar exercises during both.

Gait training continued to consist of attentional cuing for arm swing and step length. A metronome was used to increase the patient’s gait velocity and was set 5 steps/min faster than the patient’s baseline. The patient was able to increase his step length and arm swing slighty with

repetitions and cuing. The patient also took big, exaggerated steps over floor hurdles in the parallel bars.

Resistance from a sport cord was utilized during these two treatment sessions to promote higher amplitude and more intentional steps forward, backward, and laterally. Figure 2 shows the set-up for PWR! Steps forward with added sport cord resistance. The patient tolerated the added resistance well, but required stand-by-assist due to experiencing minimal loss of balance. The patient also completed PWR! Ups, Twists, and Rocks in standing as described earlier with cuing to make movements as large and fast as possible. The same parameters mentioned in the second treatment session were utilized, plus the addition of music to encourage increased speed of movement with all PWR!Moves.

Treatment Session 5

This session continued to focus on neuromuscular re-education of high amplitude maximum effort stepping movments. The patient completed PWR! Steps laterally, backward, and forward in standing to colored targets with a sport cord as he did at his 4th treatment session. The patient was challenged to count repetitions, open arms wide, and flick his fingers at the end to challenge his cognitive attention and promote brain health. He was also challenged with sport cord resistance when stepping over hurdles to encourage a more sustained effort and challenge his balance. The patient also completed foot taps on one stair and was quickly progressed to two stairs shown in (Figure 3). He began this exercise with upper extremity support from one arm and then he was challenged to not rely on any touch support to increase the difficulty. This exercise was focused on dynamic balance and stepping amplitude with the goal of carry over to to help his shuffling gait pattern. He also completed PWR! Twists and PWR! Rocks in standing as mentioned earlier with attentional cuing for bigger and quicker movments to the beat of music.

Gait training continued to consist of completing multiple laps in the hallway. A metronome was used again at 5 steps/min faster than baseline to encourage increased step cadence and attentional cues were provided to improve step amplitude and arm swing. At the end of the session the patient was encouraged to walk outdoors with his wife or on his treadmill 3-4x/week to continue to improve his motor performance.

Treatment Session 6

The patient arrived to therapy the day after having an active weekend outdoors at his lakehouse. He was able to play with his grandchildren and he reported that he was not as limited as he would have been prior to coming into therpy. He said his confidence was really starting to improve.

All of the standing PWR!Moves were completed again today but with increased difficulty to continue to challenge the patient both physically and mentally. PWR! Rocks were completed with the patient facing the wall 1 foot away and he was cued to weight shift and reach out as far as he could to the target sticky notes. This time he was on a foam air-ex pad to increase the difficulty of his weight shift and to continually challenge his dynaic balance. PWR! Twists were completed as a diagonal motion where the patient moved a weighted ball from a low cone on the floor to a sticky note high up on the wall. This exercise challenged balance, trunk rotation, and core strength while focusing on high amplitude movement. The patient also completed basic sit-to-stand transfers while holding a 20# dumbbell in the center of the patient's chest to to increase the difficulty and encourage more of the patient's posterior chain muscles to be engaged. PWR! Steps were completed with sport cord resistance again but the colored targets were moved out further to encourage larger amplitude steps. He completed steps in all directions with cuing to increase speed and amplitude. The patient was psychologically challenged by having him verbally sequence the days of the week and the months of the year during each repetition to add a dual task. This sounds easy but it can be very challenging for a patient with Parkinson's disease. This patient only had minimal difficulty with this added task.

Gait training on the treadmill was initated today to continue to focus on speed and gait mechanics. He ambulated for 10 minutes at 1.8mph with continued attentional cuing to improve gait

mechanics. A swiss ball was placed in front of the patient to encourage increased step length by having him kick it with each step. The patient responded fairly well to all of the increased challenges that were added today.

Treatment Sessions 7 and 8

The patient reported to physical therapy stating that he was having trouble going up stairs because he was losing his balance backwards and catching his toes. He noted that this has been difficult since he started therapy, but this was never reported at his initial examination.

The 7th session began by assessing the patient's ability to ascend and descend a flight of stairs to determine why he had increased difficulty. The patient was able to descend the stairs reciprocally and with good control and safety. While ascending the stairs it was observed that the patient would only step about half of his foot on each step which influenced his posterior lean, loss of balance, and ability to fully clear his feet. He was provided cuing to place more of his foot on each step and his problem was quickly corrected. With the correction, he was ultimately able to shift his weight anteriorly when pushing off and effectively clear both of his feet.

During the 7th and 8th treatment sessions the patient completed the same PWR!Moves in standing that he had completed in the 6th treatment session but the difficulty was increased by challenging the patient to move with increased speed, by adding another set of each exercise, and by adding more weight to the sit-to-stand tranfers, more weight to the low to high diagonal twists, and more resistance to the multi-directional stepping. He was still cognitively challenged by having him verbally sequence the days of the week and the months of the year during each repetition to add a dual task. The patient continued to demonstrate the need for attentional cuing to remain focused on exercise technique, speed of the movment, and movement amplitude. Treadmill training speed was increased on the 7th session from 1.8mph to 2.0mph for a duration of 10 minutes and on the 8th session from 2.0mph to 2.2mph for 10 minutes to continue to work on increasing the patient's gait velocity and also increase his work load. The patient continued to demonstrate good tolerance to both therapy sessions with only a few minor losses of balance during PWR! Rocks on the foam pad while shifting his weight and reaching side-to-side. Since the speed of the movements and the repetitions were increased during these sessions the patient did get more short of breath and required a few more rest breaks in between sets. The patient continued to demonstrate improved balance and a signicantly improved gait pattern with increased cadence and bigger step amplitude. He self-reported multiple improvements and thought that he was doing very well, so he requested his next visit be his discharge visit and he reported that he would continue with the program on his own at home.

Treatment Session 9

The patient showed up to his last therapy session 15 minutes late so his session was shorter today. He reported no new questions or concerns this date but requested his home exercise program be updated with PWR!Moves in standing.

All PWR!Moves in standing were reviewed for technique and the patient was educated on modifications for increased safety at home. The patient was re-assessed using the Berg Balance Scale. He was thanked for his full participation and consistent effort throughout his time in therapy and his permission to be in this case report. He was told to continue to be consistent with PWR!Moves at home and make them part of his daily routine. It was communicated to the patient to follow-up with physical therapy in 6 months for re-assessment unless he had any questions/concerns that needed to be addressed prior to this date.

Outcome Measures

The patient was seen for 9 total treatment sessions throughout a 6 week timeframe. His Berg Balance Scale score was re-assessed during his last therapy session and the patient scored a 55/56 compared to his intial 50/56. The BBS minimal detectable change for patients with PD is 5 so he was able to reach this milestone and overcome measurement error range to distinguish a true performance

change during the patient's re-assessment.[23] The patient's most notable functional improvements in his BBS score were in forward reaching distance, axial rotation, weight shifting, turning in a full circle, and single leg balance. The Berg Balance Scale does not measure the quality of gait or the patient's gait speed, which were two of the patient's self-reported and observed functional deficits. During his last therapy session the patient's gait pattern was re-assessed in the hallway and he subjectively demonstrated improved step length, arm swing, and increased velocity compared to his intial examination. Although the patient's gait quality and speed was assessed in the hallway during his initial/final examination, formal outcome measures were not recorded. The Timed up and Go (TUG) test could have been used to further evaluate gait speed and quality, as well as predicting fall risk. The TUG has been shown to have high retest reliability as well as sensitivity for detecting change. The TUG test may have been too simple of a task for the patient, but to increase the difficulty and challenge him, he could have performed a TUG dual task test, which involves the patient counting backwards by threes from a randomly selected number to challenge the patient mentally. Studies have supported the idea that the TUG-cognitive test increases the ability of the test to predict falls and that the increased cognitive challenge influences a greater regression of the automaticity of the gait pattern compared to the TUG test alone.[24] Lastly, a 10 meter walk test could have been performed initially and following treamtent to get an objective measurement of the patient's gait speed to determine improvements in self-selected gait speed for independence in community mobility.

During the patient's last therapy session he was asked about his goals and about the progress he felt he had made toward them. The patient reported that he had not fallen since beginning physical therapy. He had noticed an increase in his step length, an improvement in his endurance and foot clearance, and he reported that he is able to walk up stairs more efficiently without losing his balance backwards. He noted that his walking speed had increased, but that he was still not quite able to keep up with his wife's pace. One thing that was very interesting and stood out when the patient was discussing his improvements was that he noticed that his upper extremity tremors were reduced when he tried pulling back his hunting bow. The patient said that his biggest improvements were that his functional independence in the community and quality life had significantly improved since beginning physical therapy. An improvement in cognition was not mentioned by the patient or measured with an outcome assessment form.

Discussion

The purpose of this case report was to present a treatment approach consisting of gait training and PWR!Moves for a patient with PD in an outpatient orthopedic setting. The PWR!Moves were aimed at helping the patient with reducing his PD symptoms, decreasing his fall risk, improving his quality of life, optimizing his brain health, and improving his real world function. The PWR!Moves were focused on high intensity effforts and cognitive engagement which targeted 4 specific skills including antigravity extension, weight shifting, axial mobility, and transitional movements. One of the main focuses of the intervention was to teach high amplitude, maximum effort whole body movements in order to address the symptoms associated with PD. Studies have shown that an increase in amplitude or intensity can increase activation of basal ganglia circuitry and encourage synaptic plasticity in the striatum. Similarly, complex movements have also been shown to boost structural plasticity and synaptic efficacy compared to simple movements.[8] Multiple studies evaluating the effectiveness of high amplitude interventions have demonstrated very promising motor performance results. One study assessed the effectiveness of a 4 week treatment session involving large amplitude whole body movements. The subjects in the study significantly increased their speed of reaching and their self-selected gait speed at the end of 4 weeks.[8] A randomized control trial suggested that a 12-week power yoga intervention focusing on high amplitude, whole body movements significantly improved upper and lower limb bradykinesia and rigidity scores from the Unified Parkinson's Disease Rating Scale (UPDRS), quality of life, and peak power.[17] The effects of LSVT® BIG training on UPDRS-motor scores, TUG test, and 10 meter walk test were far superior compared to Nordic walking and a home exercise program for patients with mild to moderate PD.[6] Similarly, a case study conducted by Bazan-Wigle et al. (2015)

evaluated the effectiveness of PWR!Moves and treadmill training in an individual with advanced PD. The individual demonstrated significant improvements in multiple outcome measures including: sit-to-supine transfer, 2 minute walk test, 5x sit-to-stand, and Berg Balance Scale.[3]

There is a growing body of literature demonstrating the value of exercise in patients with Parkison's disease. Research has supported the idea that voluntary exercise, treadmill training, skills training, and forced limb use can encourage brain neuroplasticity in rodent models with PD and in humans with neurological impairments such as stroke and spinal cord injuries.[7] Throughout the available research, no interventional approach for patients with PD has demonstrated consistent superiority to other potential interventions. Currently, there is no "gold standard" treatment approach for patients with PD. Future research studies should focus on reporting well established exercise parameters to be able to compare more effectively across studies. Studies should also focus on comparing the results of interventions across disease severity cohorts. Lastly, the use of brain imaging techniques could be used to determine the effect of various PD interventions on damaged basal ganglia circuits.

This case report is an example of an intervention consisting of both gait training and PWR!Moves having a positive impact on an individual with Parkinson's disease. Similar to results reported in the literature regarding high amplitude movement interventions, the patient in this case report significantly improved his Berg Balance Scale score, demonstrated an improved gait pattern, and self-reported many functional improvements during his last treatment session. It is important to note that this is a case report of just one individual with Parkinson's disease; therefore, the information in this case report cannot be generalized to the rest of the PD population, and it cannot be ruled out that other interventions would not have provided similar results. However, it provides additional preliminary evidence supporting the use of high amplitude, maximum effort tasks in PD rehabilitation.

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