



Parkinson's Disease

A Clinical Guideline for the Treatment of Patients with Parkinson's Disease using Biodex Technology.

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BIODEX

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1. Introduction

Biodex Medical Systems, Inc. has been providing innovative medical devices and service excellence for more than 60 years. We're especially proud of this accomplishment and earned it the old-fashioned way – by putting our customers and employees first. It all begins with our belief in science-based solutions.

At Biodex, over 200 employees strive to keep our customers at the forefront of the art and science of medicine. It's no wonder so many world-class facilities call Biodex first.

Within this guide you will find an overview of the signs and symptoms common to Parkinson's disease along with recommended treatment strategies. Online eLearning courses are available on the Biodex website: www.biodex.com/elearning.

An Impairment-Specific Quick Tips Guide, located in the back of this document, is intended to provide treatment strategies at a glance, directly related to specific impairments.

2. Purpose

This Clinical Resource Guideline is intended to be used as a guide and not to supersede clinical judgment or a therapist's decision-making process. The role of the Guideline is to improve patient outcomes as well as increase overall department efficiency. By incorporating traditional examination/evaluation techniques with today's level of technology, Biodex products will assist in maximizing therapist time management and effectiveness. The utilization of standardized, objective testing/training devices can make treatments easily reproducible.

The above, combined with integrating research, will assist with the creation of an evidence-based productive practice where tradition and technology meet. Health care workers are advised to make individual treatment decisions according to their own medical judgment in light of each patient's individual circumstances.

Following completion of this Clinical Resource Guideline on Parkinson's disease the anticipated outcomes are as follows:

- Demonstrate a commitment to personal and professional growth with valid and reliable information.
- Guide healthcare professionals in the clinical decision-making process for developing a plan of care and intervention strategy when utilizing Biodex technology.
- Communicate clear and concise guidelines to assist in the education of therapists and healthcare professionals.
- Assist in guiding healthcare providers to function as independent problem solvers in the practice environment relating to neurologic impairment and training on Biodex technology.
- Supplement the theoretical learning of physical therapy pertinent to Biodex medical device testing and training with a carryover to functional activities.
- Integrate knowledge of neurological testing/training and physical therapy in order to modify treatment approaches that reflect the breadth and scope of health care practices.

3. Overview of Parkinson's Disease

Parkinson's disease is a progressive neurodegenerative disorder that affects movement, muscle control and balance as well as numerous other motor and non-motor functions. Parkinson's disease is characterized by specific motor impairments. The hallmark symptoms of Parkinson's disease are typically asymmetrical tremors at rest, rigidity, bradykinesia, and problems with postural stability.

The underlying disease process of Parkinson's disease involves the death of dopamine-producing cells. The reduction of available dopamine in the brain is what directly affects motor function. Early symptoms of Parkinson's disease are subtle and occur gradually. As the disease progresses the symptoms usually become more pronounced and the severity of movement disorders increase.

There is currently no cure for Parkinson's disease; the disease process is chronic and progressive in nature. The rate of progression varies from person-to-person, as does the intensity of symptoms. Although Parkinson's disease can be debilitating and significantly impair quality of life, it is not a fatal disease. Many people live with Parkinson's into their advancing years. Both male and females are equally diagnosed with Parkinson's disease, although, after the age of 60, there is a higher incidence in males of acquiring the diagnosis of Parkinson's.

Types of Parkinson's Disease

Adult-Onset Parkinson's Disease

This is the most common type of Parkinson's disease. The average age of onset is approximately 60 years old. The incidence of adult onset Parkinson's disease rises noticeably as people advance in age into their 70s and 80s.

Young-Onset Parkinson's Disease

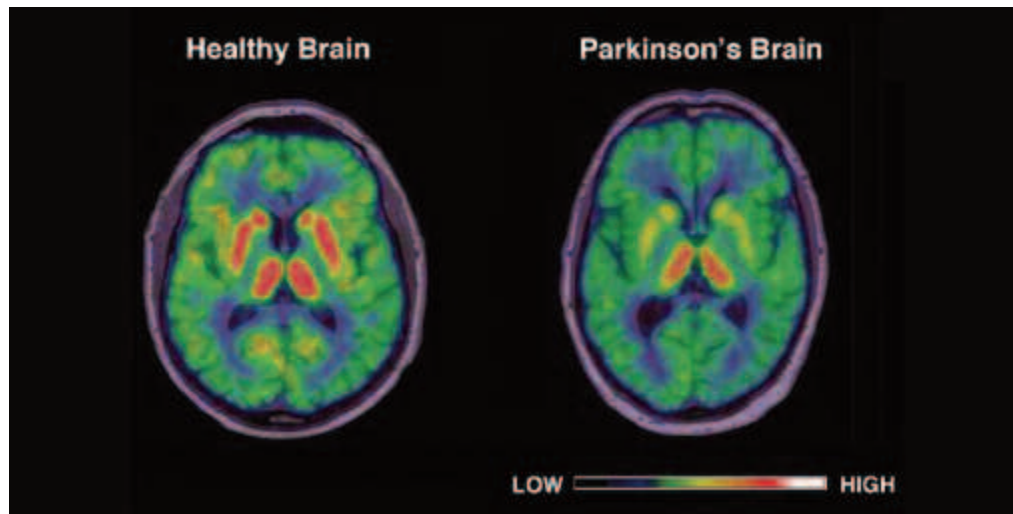
The age of onset is between 21-40 years old. Though the incidence of Young-Onset Parkinson's disease is very high in Japan (approximately 40% of cases diagnosed with Parkinson's disease), it is still relatively uncommon in the U.S., with estimates ranging from 5-10% of cases diagnosed.

Juvenile Parkinson's Disease

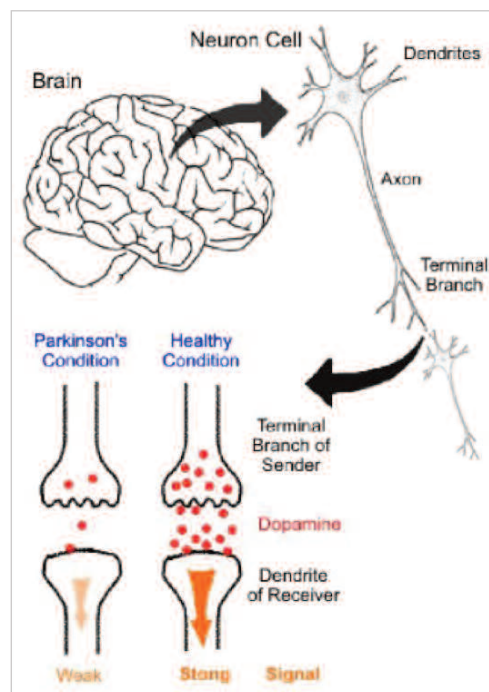
The age of onset is before the age of 21. The incidence of this type is very rare.

Pathophysiology of Parkinson's Disease

Deep in the brain, distal to the cerebral cortex, is an area of connected grey matter called the basal ganglia. The basal ganglia are made up of structures called the caudate nucleus, putamen and globus pallidum internus – all three structures are involved in controlling voluntary movement. Next to the basal ganglia are clusters of nerve cells called the substantia nigra. These cells produce dopamine. Dopamine is an important neurotransmitter that is responsible for transmitting electrical signals between the nerve cells that regulate movement. When there is a loss of the neurotransmitter dopamine the nerve cells start to fire out of control, resulting in declined controlled muscle activity. Motor symptoms classic to Parkinson's disease will then become present, specifically akinesia, bradykinesia, tremors and others.



Brain with and without Parkinson's disease



Physiology of Dopamine

Causes of Parkinson's Disease

Researchers have not been able to determine the actual causes of Parkinson's disease. Most cases, approximately 85 percent, are idiopathic. Some research has discovered that there may be a specific genetically-linked abnormality in family members. Although adjunct research has discovered that in large groups of people diagnosed with the disorder, there was no specific common-genetic abnormality that could be identified. Other research studies have found that genetic testing is only likely to show hereditary tendencies in people who develop the condition before the age of 30 years.

There is also some evidence that points to certain toxins in the environment that may cause Parkinson's disease including manganese, carbon monoxide, carbon disulfide and other pesticides. Researchers found that these toxins slowly destroy the neurons that produce dopamine.

Another possible cause for Parkinson's disease is due to oxidative stress. Oxidation is a process in the human body where damage to cell membranes and other structures affect neurons. Antioxidants protect cells from damage. Researchers have found that people with Parkinson's disease have excess free radicals which overtake the antioxidants. This mismatched ratio is another element that damages the cells that produce dopamine.

Occupational exposure to metals, specifically copper, mercury, iron, lead, and zinc may also be a contributing factor to individuals that are diagnosed with Parkinson's disease.

Signs and Symptoms of Parkinson's Disease

Cardinal Signs

The diagnosis of Parkinson's disease depends upon the presence of one or more of the four most common motor symptoms of the disease. The four motor symptoms listed below are considered cardinal in Parkinson's disease: tremor, rigidity, slowness of movement, and postural instability.

1. **Tremor:** The most apparent and common symptom, although approximately 30% of individuals with Parkinson's disease do not have tremor at the onset of the disease. The tremor typically begins as a resting tremor, and will disappear with voluntary movement and sleep. The distal part of the limb is the most common area to be involved. The tremor starts out unilaterally and becomes bilateral as the disease progresses. A common feature of Parkinsonian tremors is called *pill rolling*; the tendency of the index finger of the involved hand to make contact with the thumb and perform together in a circular movement.
2. **Rigidity:** Causes stiffness and lack of flexibility in the upper and lower extremities, neck and trunk. Muscles normally have good plasticity during movement and rest. In Parkinson's rigidity, the muscle tone of an affected limb is always stiff and does not relax. This typically contributes to decreased range of motion and partly causes difficulty with reciprocal movement patterns. Rigidity can be uncomfortable or even painful
3. **Bradykinesia:** Slowness of movement is another characteristic feature of Parkinson's disease. It is associated with difficulty with the movement process, from planning to initiation and to execution. Bradykinesia is commonly a very disabling symptom in the early stages of the disease. Initial manifestations are problems when performing daily tasks which require fine motor control such as writing and getting dressed. Bradykinesia is not equal for all movements, nor does it present consistently. Most times it is modified by the activity or emotional state of the subject. Generally, people with Parkinson's disease have less difficulty when some sort of external cue is provided.
4. **Postural Instability:** One of the most important signs of Parkinson's disease is postural instability; a tendency to be unstable when standing upright. A person with postural instability has lost some of the necessary reflexes needed for maintaining an upright posture, and may topple backwards if jostled even slightly. Some develop a dangerous tendency to sway backwards – called *retropulsion* – which can result in a backwards fall when rising from a chair, standing, or turning.

Secondary Motor Signs and Symptoms

- **Festination:** This motor sign is classified as rapid shuffling steps and a forward-flexed posture during gait.
- **Freezing:** People who experience freezing will normally hesitate before stepping forward. They feel as if their feet are glued to the floor. More often than not, freezing is only temporary. Once they take that first step, a person can continue with normal steps. Freezing can occur in very specific situations, such as when starting to walk, when pivoting, when crossing a threshold or doorway, and when approaching a chair. Various types of cues, such as an exaggerated first step, can help with freezing.
- **Dyskinesia:** Refers to a category of movement disorders that are characterized by involuntary muscle movements similar to tics. Dyskinesia can be anything from a slight tremor of the hands to an uncontrollable movement of the upper body or lower extremities.
- **Hypokinesia:** A pathology created due to a lack of stimulus within the portion of the brain called the basal ganglia, resulting in abnormally diminished muscular function or mobility.
- **Akinesia:** A slowness or loss of normal motor function resulting in impaired muscle movement.
- **Micrographia:** This term is the name for a shrinkage in handwriting that progresses the more a person with Parkinson's writes.

Non-Motor Signs and Symptoms

Neuropsychiatric/Autonomic

Parkinson's disease can cause neuropsychiatric disturbances, which can range from mild to severe, including speech, cognition, mood, behavior, and changes with thought process. Non-motor clinical signs and symptoms are important to consider when rehabilitating a patient with Parkinson's disease, as these disturbances can either negatively, or at times, positively influence a patient's motor ability.

Other non-motor signs and symptoms:

- | | |
|------------------------------|------------------------|
| • Weight loss or gain | • Skin problems |
| • Vision and dental problems | • Sleep disturbances |
| • Fatigue and loss of energy | • Thought alterations |
| • Depression | • Sensory disturbances |
| • Fear and anxiety | |

Cognitive Signs and Symptoms

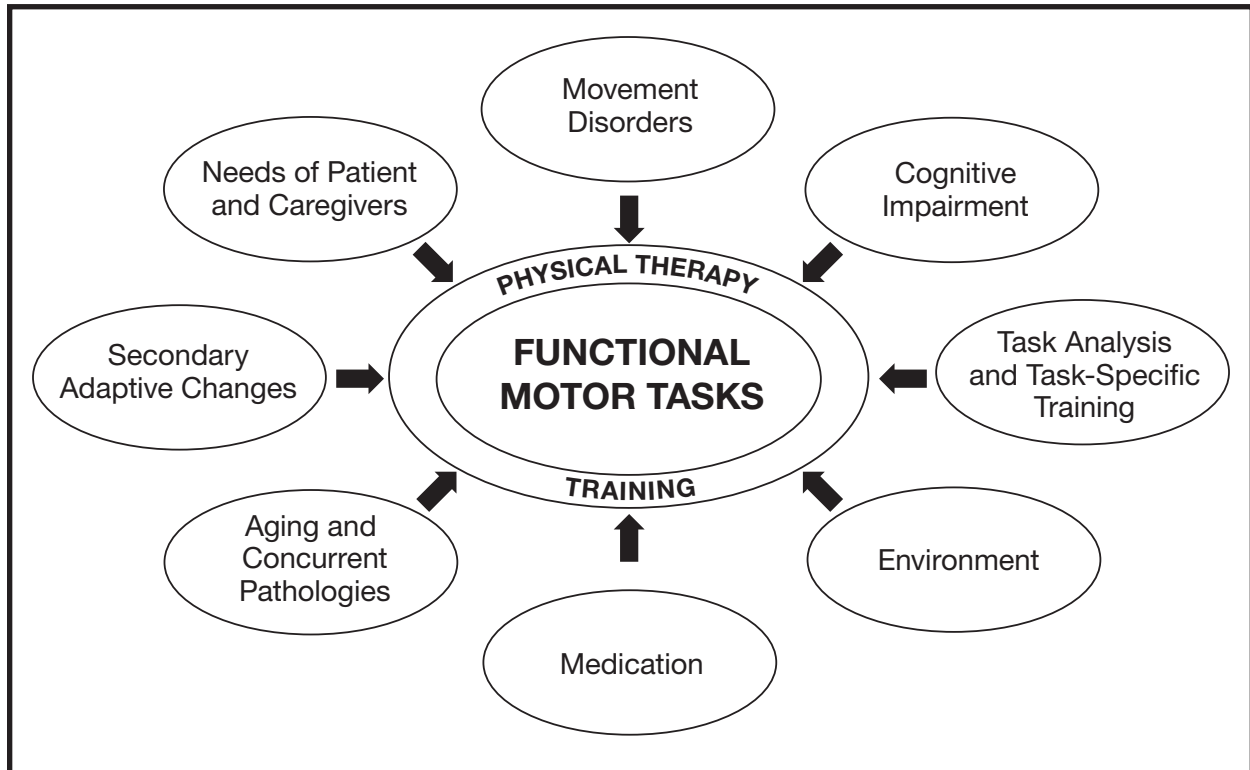
Cognitive disturbances can occur in the initial stages of the disease and sometimes prior to diagnosis. They typically increase in prevalence with duration of the disease. The most common cognitive deficit is called executive dysfunction. The patient will display problems with planning, cognitive flexibility, abstract thinking, rule acquisition, initiating appropriate actions and inhibition of inappropriate actions and statements. At times, the inability to filter relevant sensory information becomes challenging. Fluctuations in attention and slowed cognitive speed are common cognitive deficits. Memory is affected, especially in recalling information. Improvement may result when recall is aided by cues.

A person with Parkinson's disease has 2-6 times the risk of dementia compared to the general population. The prevalence of dementia usually increases with duration of the disease. Patients with Parkinson's disease, combined with dementia, will most likely have greater behavior and mood alterations. The most frequent mood difficulties are depression, apathy and anxiety. Lack of impulse control is usually present. Psychotic symptoms such as hallucinations or delusions may be present. These symptoms become more common with increasing age and levodopa intake.

Autonomic Signs and Symptoms

- Orthostatic hypotension
- Dysphagia
- Esophageal dysphagia
- Weight loss
- Thermoregulation
- Hyperhidrosis

4. Influencing Factors on Performance of Motor Skills



Physical Therapy – Before Getting Started

CAUTION: Patients should be medically stable before starting an active program of physical therapy. Tests and measures used in this Guideline should only be performed with medically stable patients.

Stability should be achieved in:

- Prescription medication
- Blood pressure, circulation and respiration
- Mental capacity for cognition and behavior
- Bowel/bladder control
- Decreased or absent sensation and proprioception should also be noted

Patient Considerations

Treatments should be modified based on the patient's response and with the patient's well-being in mind. Breaks should be incorporated throughout the treatment session as needed, especially with patients who have cardiac, pulmonary dysfunction, and/or general deconditioning.

Physical Therapy – In the Clinic

Evaluation and Rehabilitative Care Plan

Role of the Physical Therapist

Because people with Parkinson's disease vary considerably with respect to their rate of progression, impairments, activity limitations, participation restrictions, and quality of life, there can be no single recipe for physical therapy treatment. Each person needs to be assessed individually so that the physical therapist can provide a specifically-tailored program to meet the needs of the patient. Throughout the 10- to 45-year time course of the disease progression, physical therapy goals and strategies need to be adapted to ensure that the person receives interventions that are suitable to address the needs of the patient at each stage in their rehab. The needs of a newly diagnosed person who is at stage I on the Hoehn and Yahr scale, and has mild slowing and under-scaling of movements, are very different from those of the person at stage IV who has had a long-standing disease process. More than likely, at stage IV, they are now experiencing loss of balance, falls, hypokinesia, and possibly other movement disorders such as rigidity, tremor, dyskinesia, and dystonia.

During the initial evaluation and throughout the course of treatment the physical therapist should be mindful of which rehabilitative phase the patient is in. In the early phases of Parkinson's disease the goal will most likely be in maintaining the patient's independence, safety and well-being throughout movement and exercise. In the early stages of the disease, maintenance is key. As the disease progresses, it is important to improve movement patterns and to work on preservation of skills. Approaching the late phase of their disease process, it is important to preserve vital functions and prevent complications, such as pressure ulcers and contractors.

Evaluation

Based on the initial evaluation, findings and ongoing reassessment, the therapist determines the objectives from each session and develops a plan to meet the objectives. The plan should include the appropriate treatment type, extent of treatment, assistance levels and facilitatory needs. Frequency and duration must also be decided upon.

Once determined, the therapist obtains vital signs, including blood pressure, heart rate, and blood oxygen level through pulse oximetry. If the vital signs are within normal limits, proceed. If the patient's levels are unstable, the therapist should always use their clinical judgement to take the appropriate steps to assure patient safety levels.

The following steps are a guideline to move clinicians through the rehabilitative phases:

CAUTION: This Clinical Resource Guideline is intended to be used as a guide and not to supersede clinical judgment or a therapist's decision-making process.

1. Examination/evaluation of all patients to determine baseline motor impairments; sitting/standing balance and function will reveal data to develop the Rehabilitation Care Plan.
2. For patients who have some voluntary control over movement, exercises for remediation of impairments is recommended. The recommended activities will focus on increasing postural sway, improving endurance, motor control, strength and function.
3. For patients with persistent movement and sensory deficits that cannot be remediated, teaching alternative or compensatory methods for performing functional tasks and activities, including gait training, practice of activities of daily living and community activities, are recommended.
4. Patient and family education is an integral part of the rehabilitation process, particularly when a patient is discharging to home.
5. Individualized decisions should be made about the prescription of adaptive and assistive devices, e.g., cane, walkers, commode chairs, and reachers.

Evaluation Activities

- **Pre-functional:** Activities that will be related to a functional activity at a later time; these may include range of motion, stretching, manual therapy techniques, and setup of an assistive device.
- **Bed mobility:** Encourages mobility to engage core musculature in preparation for upright sitting and standing as well as rolling side to side.
- **Sitting:** The major weight-bearing surface is the buttocks: supported, unsupported, static, or dynamic sitting. Focus may be on improving head or trunk control, balance, and strengthening of proximal musculature.
- **Transfers:** The process of moving from one position to another, or transferring from one object or surface to another
- **Sit to stand:** The ability to shift weight and maintain postural control when moving from sit to stand, anterior weight shift needed to assume upright.
- **Balance:** The aim of physical therapy in people with Parkinson's disease is to increase the variability of mobility and promote increased postural movement.
- **Ambulation:** The ability to walk from place to place independently, with or without an assistive device. Specific components will be looked at pertaining to symmetrical weight bearing, foot clearance, weight-shifting ability, hip/knee position when weight bearing and ankle/foot kinematics.
- **Community Mobility:** Any training to assist the patient in accessing the community, such as buses, stores, recreational facilities, etc. This may involve learning to use a transportation system or how to safely cross the street or use curb cuts.

Interventions

Direct Interventions

There are numerous approaches to rehabilitation for patients diagnosed with Parkinson's disease. Specific performance in any area is most likely to improve when motor activity is willful, repetitive and task oriented.

Rehabilitation is multi-faceted and may include some or all of the following activities:

- **Postural awareness:** The awareness of the alignment and position of the body in relationship to gravity, center of mass, and base of support.
- **Motor learning:** A set of processes associated with practice, leading to a permanent change in the capacity for skilled action.
- **Mobilization:** A manual therapeutic technique that fosters movement in stagnant tissues and joints and assists in breaking down scar tissue.
- **Strengthening:** Involves using exercises to help improve your muscle strength and coordination.
- **Cueing Strategies:** The performance of automatic movement responses is diminished in Parkinson's disease due to problems of internal control. Cues are used to compensate for the reduction in internal control. Cues can be auditory, tactile or vibratory.
- **Mobility training:** May include learning to use walking aids, such as a walker or canes, or a plastic brace (orthotic) to stabilize and assist ankle strength to help support the body's weight while relearning how to walk.
- **Range-of-motion:** Exercises and other treatments to help lessen muscle tension (rigidity) and regain range of motion.

Educational Interventions

A very important part of the rehabilitation plan is education for the patient, family and caregiver. Clinical patient education should be planned and systematic to optimize learning. The goals for this education are to assist the patient to resume their quality of life.

Patient Education

The process where health professionals communicate information to patients that will assist in improving their health behaviors as well as improve their health.

Family/Caregiver Education

The process where the health care worker informs the caregiver of the disease progression and how to care for the patient.

Equipment

Assistive devices are a necessary factor to address when preparing the Rehabilitative Care Plan.

Traditional

- Many patients require assistive devices, adaptive equipment, mobility aids, and wheelchairs to maximize function. Type and level of impairment, function and the characteristics of the patient's environment will be necessary information to determine need.
- There are many different types of devices available to assist with ADLs, including those for mobility. These devices should only serve as a supplement and should not be expected to take the place of the patient relearning the skill.
- It is recommended that adaptive devices be used for safety and function if other methods of performing the task are not available.
- It is also recommended that lower extremity orthotic devices and walking devices be considered if ankle or knee stabilization is needed to improve the patient's gait and prevent falls.

Technology

- The trend in therapy is to create protocols that help patients every day. Traditional strength, balance, and gait training is necessary during rehabilitation treatments.
- Technology has a major role during a patient's rehabilitative process. It assists in creating greater therapist efficiency and measureable/reproducible treatment techniques. Technology gives patient's a visual (and often motivational) display of their performance when working toward therapy goals.
- Technology aids, combined with advancing research-based protocols, continue to optimize patient care.

Biodex Equipment

- | | |
|-------------------------|------------------------|
| • Balance System™ SD | • Gait Trainer™ 3 |
| • VibroTactile™ System | • Unweighing System |
| • medBike® | • FreeStep SAS |
| • BioStep® 2 Elliptical | • System 4 Dynamometer |
| • Sit2Stand™ | |

5. Fall Risk for Parkinson's Disease

In upright standing, many individuals with Parkinson's disease have reduced postural sway due to hypokinesia (under-scaling of movement speed and size), unlike people who have experienced a stroke, traumatic brain injury, or multiple sclerosis and have increased postural sway. This lack of sway and reduced variability of movement seems to be a major contributing factor that predisposes people with Parkinson's disease to falls. Posture and movements are regulated and lack the adaptability that enables a person to adjust his or her posture. The aim of rehabilitation is to reduce a patient's fall risk and increase the variability of their mobility. Repetition and practice of task appears to improve one's ability to perform functional movements.

In addition to the cardinal signs affecting the rate of falls in people with Parkinson's disease mentioned above, there is evidence that has clarified why patients with Parkinson's disease frequently fall during transfers. It has been related to dual tasking events. Also, the reduction in reciprocal arm swing and freezing plays a major factor in falling as well. A history of falls for the patient with Parkinson's disease is a predictor for recurrent falls. Patients at a level 3 and above on the Hoehn and Yahr mobility scale were 95 percent at risk for falls.

Evaluating the Patient for Fall Risk

Fall Risk Screening Test

Utilizing Biodex Balance Technology (Balance System SD)

Three trials, 20 seconds each. Each trial begins with a platform setting of 12 and ends with a platform setting of 8. A composite score is calculated and compared to normative data.

- Document foot position
- Comfortable stance
- Hands to remain at patient's sides
- Eyes open
- Must maintain center without falling

Trial Time	Initial Platform Setting (More stable)	Ending Platform Setting (Less stable)
20 seconds	12	8

Treating Patients at High Risk for Fall

Vibrotactile Cueing

Biodex devices: VibroTactile System and Balance System SD

The VibroTactile System is an accessory for the Balance System SD and provides tactile (vibration) cueing. This stimulus heightens somatosensory input to accommodate impaired regulation of equilibrium and postural control.

Recommended modes using vibrotactile cueing:

- **Postural Stability:** Reduced variability of movement, finding center, and working on internal control mechanism for automatic movement patterns. Increase target distance to increase movement excursion, cueing from vibration will assist with task completion.
- **Weight-Shift Training:** Address spatial and temporal relationships for improving postural control. Visual and tactile stimulus assists with movement in the M/L and A/P planes. Increase excursion of movement. Add diagonal patterns.
- **Limits of Stability:** Tactile cueing will assist with movement patterns inside and outside of sway envelope. This training mode increases a patient with Parkinson's disease movement excursions as well as improves movement initiation.
- **Random Control:** Increase target speed. Vibratory input will create positive feedback loop.

Supported Ambulation

Biodex devices: FreeStep SAS (Supported Ambulation System)

The FreeStep provides a safe environment for patients to participate in full weight-bearing activities while addressing functional activities but with a decreased fall risk.

Cognitive questions combined with multi-plane walking, step ups/step downs, and rhythmic marching will help increase dual tasking abilities and improve motor skills.

Balance Technology

Biodex devices: Balance System SD

Addresses reduced variability of movement, core stability in addition to proprioception. Vestibular and vision are called upon to assist the patient to remain upright when unexpected variables affect stability levels.

- Weight-Shift – small/large movement excursions
- Maze Control – variable speeds

6. Patient Mobility Classification

Hoehn and Yahr Staging of Parkinson's Disease

Stage 1	Not disabling. Mild, unilateral symptoms (e.g., tremor, posture, locomotion and facial expression).
Stage 2	Bilateral involvement, without impairment of balance. Possibly already a light kyphotic posture, slowness and speech problems. Postural reflexes are still intact.
Stage 3	Significant slowing of body movement, moderate to severe symptoms, postural instability. No recovery on the retropulsion test. Walking is impaired with decreased reciprocal mobility, though still possible without help. Physically independent in ADLs.
Stage 4	Severe symptoms. Rigidity and bradykinesia. Partly disabled. Walking is impaired. Volitional movement ability is diminished. Assistance may be required.
Stage 5	Globally impaired. Walking and standing are impossible without help. Continuous care is necessary.

Classification of the Patient with Neurological Involvement

It is important for the therapist to first classify the impairment of the body function(s) of the patient.

The therapist should refer to the common characteristics and impairment of body functions(s) stage categories below to determine each patient's rehabilitation phase.

Neurological Impairment: Supervised-Independent

Hoehn and Yahr stage 1-2

- Display a good static/dynamic standing balance, requires only tactile and verbal cues for alignment.
- Stands greater than five minutes without physical assistance.
- Demonstrates a functional level of confidence with mobility and is independent with most activities.
- Slight tremors and reduced facial expressions may be present, although there is zero effect of these symptoms on functional mobility.
- Ambulatory without an assistive device with no greater than tactile and verbal cueing; distance may be limited, steps remain small and cadence is slowed.

Neurological Impairment: Supervised

Hoehn and Yahr stage 2-3

- Displays minimal deficits with static/dynamic standing activities.
- Demonstrates a good confidence level during mobility and may only require contact guard or supervision from the therapist for higher level balance and weight-shifting activities.
- Verbal cueing may be necessary for completion of higher-level motor tasks.
- Demonstrates a very good attention span and follows multi-step directions without difficulty.
- Continues to be independent with ambulation, steps remain slow and small. Festinating gait pattern may be present; "freezing" may be mildly apparent with surface changes.

Neurological Impairment: Minimal

Hoehn and Yahr stage 3-4

- Demonstrates decreased dynamic and static standing balance, requires supervision to minimal assistance.
- May tolerate 3 to 5 minutes of standing with minimal assistance to supervision.
- Demonstrates confidence with movement and may only require minimal assistance to supervision from the therapist to complete activities. Reaction and processing time may be slowed. May have kyphotic posture.
- Requires minimal assistance and/or verbal cues for weight shifting and balance activities. Fall risk high due to decreased postural sway.
- May have small difficulties with dual tasking, although attention span remains good.
- May remain independent with ambulation, although assistance will probably be required. Walking speed is slowed and steps are short, gait will be festinating and propulsive. Freezing may start to occur when changing terrains. Patients at this level remain fairly independent with ADL activities.

Neurological Impairment: Moderate

Hoehn and Yahr stage 4

- Static and/or dynamic balance is limited, requiring assistance for weight shifting and balance activities.
- Fear of movement with increased risk of fall due to decreased postural sway.
- Requires minimal to moderate therapeutic assistance to tolerate weight-shifting activities. Transitional mobility is labored due to rigidity and bradykinesia, diminished reciprocal movement patterns; cueing is required to complete some movement patterns.
- May have difficulty with performance of 2 to 3 step commands combined with a delayed response time.
- Motor impairments result in the patient requiring moderate assistance with ADL or other self-care activities. An assistive device may be necessary for gait due to high fall risk. Reciprocal movement patterns are diminished. Gait may be festinating with difficulty starting and stopping movement. Freezing will occur, gait speed is slow.
- May have an increase in kyphotic posture and tremors.

Neurological Impairment: Profound

Hoehn and Yahr- stage 5

- The long-term motor complications of Parkinson's disease are due to the duration of disease and to the cumulative intake of L-Dopa. Central and peripheral motor involvement is severe. Bradykinesia and tremors, which may or may not be present, will typically dominate fine motor control. Rigidity is apparent throughout the extremities and trunk. The patient is usually forward flexed due to the severity of spinal kyphosis.

It is very important for patients at this stage to engage in fall prevention utilizing strength, balance, assisted ambulation strategies and activities that will assist with movement initiation.

- Exercise should be timed accordingly, based on the application of medication intake. This will result in improved motor coordination and skills.
- Presents with poor static and dynamic balance, requiring total to maximal assistance to remain upright in standing and sitting. The patient may only tolerate sitting and standing for very short periods of time even with assistance.
- Demonstrates a significant fear of movement and or poor volitional motor control.
- Impairments result in the patient requiring total to maximal assistance with ADLs and motor skills, including bed mobility, transfers, sitting, standing and walking activities.
- The patient is at a very high level of fall risk.

7. Balance and Mobility Classification Reference

CAUTION: The following training conditions are for the general population with neurological impairment. Not all conditions stated below will be applicable for the Parkinson's diagnosis. Clinical judgment should always supersede guidelines.

Activities – Postural Control

Applicable for Profound Neurological Impairment

The focus of this category will be on maintaining range of motion, maintaining muscle strength and improving volitional movement. Most patients at the profound level will generally not be able to participate in any testing regimens. They are working on their mat skills, transfers and maintenance of range of motion and strength. Hoehn and Yahr Stage 5 patients are typically focused on their transitional mobility such as rolling, performing supine to sit, and sit to stand. They are also working on volitional movement in sitting with assist and identifying their midline, as well as attempts at standing. They are generally getting used to placing weight through their lower extremities and finding their center of gravity in standing. To assist with standing activities the use of the Unweighing System helps ensure safety against falls.

Unweighing System/Gait Trainer

The patients at this mobility level either cannot stand or may require maximal assistance to stand. They have a quick fatigue rate (poor endurance). Once donned (see the BWSTT Clinical Guideline for specific donning and doffing instructions) the Unweighing System can be helpful to assist in standing for short periods of time. The patients can stand at a walker or be mechanically lifted to stand with utilization of a hi/low table. Through controlled reduction of weight bearing during upright standing and ambulation, the Unweighing System attempts to provide postural support and promote coordination of the lower extremities. The decrease in weight bearing is intended to minimize the stress and demands on the muscles, in theory, allowing the patient to develop more effective and efficient movement strategies.

Recommendations

- For the profoundly affected patient initiate the treadmill at .5 mph. The therapist can then assess gait kinematics and postural control while monitoring vital signs. Adjustments may be needed based on patient's alignment and tolerance level.
- Gait training performance may be variable. It is important to obtain a baseline by having the patient participate, as per individual tolerance, between one and two minutes initially, or based on the patient's tolerance.
- Therapist examines and assesses the patient during the baseline ambulation trial.
- If vitals are unstable and/or the patient is not feeling well, the clinician should take the necessary steps to assure patient safety.

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- Based on clinical presentation of the patient, the therapist uses clinical judgement as to when to adjust the speed and step length.
 - Two trials (or as per patient's tolerance) in duration is recommended for initial contact. Frequency increased or decreased as per patient response.

Activities – Dynamic Weight Shifting

Applicable for Moderate and Minimal Neurological Impairment

The focus for patients in this category will be on volitional control of movement and strengthening the core and extremities. The goal for patients with moderate and minimal neurological impairment will be to display voluntary weight-shifting activities.

The patients within this category are:

- Building endurance and working on automatic movement patterns.
- Improving strength and maintaining range of motion.
- Perform assisted standing activities
- Working on maintaining volitional movements during dynamic activities and their ability to perform standing balance activities while reducing rigidity.
- May be able to complete approximately 3-5 minutes of training before resting. With usage of the Biodex Unweighing System and Gait Trainer, patients can walk short distances.

BioStep

The BioStep can be used to improve tolerance to activity, improve endurance as well as assist with range of motion, reciprocal movement patterns and strengthening. This level of patient can tolerate longer bouts of therapy compared to profound-level patients, although initial bouts of activity on the BioStep should be limited and based on patient's tolerance levels.

Recommendations

- Patients should rate their perceived exertion from the Borg CR10 scale.
- Levels of perceived exertion should be at an optimal level of 4-6 exertion.
- Recommended initial trials of activity should be 2 to 5 minutes each trial; clinical judgement should be made pertaining to the patient's HR/RR monitoring and the patient's subjective complaints.
- The patient's vitals should be assessed pre- and post-exercise.

medBike

The medBike can be used to improve endurance, strength and range of motion. Patients at this mobility level can tolerate longer intervals of training than patients that are profoundly involved, although intensity and duration should always be based on a patient's activity tolerance. The medBike allows for multiple levels of patients to safely exercise as there are variable modes, including: active, passive, and pedal assist.

Recommendations

- Patients should rate their perceived exertion from the Borg CR10 scale.
- Levels of perceived exertion should be at an optimal level of 4-6 exertion.
- Recommended initial trials of activity should be between 2-5 minutes each trial; clinical judgement should be made pertaining to the patient's HR/RR monitoring and the patient's subjective complaints.
- Modes can be interchanged between active, passive and pedal assist dependent on patient's tolerance to the level.
- Patient's vitals should be assessed pre- and post-exercise.

Sit2Stand

The Biodex Sit2Stand can be used to assist in regaining muscle strength and endurance. It can also assist with isolated muscle control, which is imperative to a patient with Parkinson's disease. The sit-to-stand movement is the precursor to function, transitional mobility and ambulation.

Recommendations

- Endurance Training: 3-4 days per week, short rest periods
- Range of Motion: 5-6 days per week, move slowly through range of motion
- Resistance Training: 3-4 days per week, increased repetition speed

Balance System SD

Initially patients can focus on simple anterior/posterior and medial/lateral weight shifting with visual feedback. The Limits of Stability training mode can be used to challenge both A/P and M/L weight shifts as well as diagonal weight shifting. Recommended balance activities are below. Within each training mode, the difficulty level can be adjusted by varying the platform stability.

Recommendations

- Weight-Shift Training - Adjust A/P and M/L skill level and platform stability, frequent rest periods and UE support/maximal assist will be required. Duration for standing activities may be limited due to increased rigidity and poor endurance.
- Limits of Stability Training - Adjust target skill level and platform stability.

Balance System SD and Vibrotactile Cueing

The Biodex VibroTactile System is an option for the Balance System SD to provide tactile cueing. This stimulus heightens somatosensory input to accommodate impaired regulation of equilibrium and postural control.

Recommendations

- **Postural Stability** - Finding center and working on internal control mechanism for automatic movement patterns. Vibration cueing will help improve postural stability as it will vibrate (positive feedback) when the patient maintains their sway envelope.
- **Weight-Shift Training** - Addresses spatial and temporal relationships for improving postural control. Visual and tactile stimulus assist with movement in the M/L and A/P planes.

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- **Limits of Stability Training** - Vibrotactile cueing will assist with movement patterns, inside and outside of the sway envelope.
 - **Maze Control** - Vibrotactile cueing will assist with automatic internal control for voluntary movement.

Unweighing System and Gait Trainer 3

The patient may tolerate treadmill training time via unweighing the body up to 40 percent of body weight, utilizing the system to improve postural control (see the BWSTT Clinical Guideline on how to safely utilize the system harness, determine percent of offloading and navigate through Gait Trainer operations). The Biodex Gait Trainer provides audio and visual biofeedback which is useful in retraining the automatic movement pattern deficits associated with Parkinsonian Gait. The patient focuses on the visual and audio cues, which help to regulate stride and step length. The Gait Trainer 3 combined with the Unweighing System can be used for pre-gait activities, weight shifting, working on average step length, step length variability and time spent on each foot for improving symmetrical weight bearing and weight shifting. The patient can also work on increasing their walking speed to work on cadence, or reduce their speed to accommodate propulsive gait patterns.

Recommendations

- Initiate training based on the patient's self-selected speed determined from the 10-meter walk test performed over ground. Therapist observes and assesses gait kinematics, postural control and facilitates in areas needing support.
- Vital signs are monitored for evidence of distress and are adjusted accordingly.
- To progress this patient the goal is to increase the speed of the Gait Trainer above the patient's comfortable self-selected speed by .1-.2 mph. The patient must demonstrate optimal gait kinematics and endurance with little compensatory strategies. The therapist evaluates the patient's gait presentation and varies speed and offloading percentage accordingly.
- Based on clinical presentation of the patient, the therapist uses clinical judgement as to when to adjust the speed.

Activities - Reactive Postural Control Training

Applicable to Supervised and Supervised-Independent Neurological Impairment

Advanced rehab activities require the patient to respond to unplanned or unanticipated challenges during mobility. This type of control is essential for reducing fall risk during unintended loss of balance, such as slipping or tripping, while performing dynamic activities due to rigidity or multitask performance. Patients at this independent level can work on improving their levels utilizing the BioStep, and address lower-extremity strength on the Sit2Stand. Training on the Unweighing System/Gait Trainer 3 will improve the components of gait including weight shifting, gait speed and step length. The focus with the independent to supervised level patients will be on time spent practicing over ground activities. The Balance System SD will continue to assist in improving core stability, upright postural control/sway and anticipatory control. Vibrotactile cueing combined with utilization of the Balance System SD will enhance sensory input with tactile stimulus.

WARNING: Before any patient is to participate in cardiovascular activities, they must be medically stable and receive clearance from their physician.

BioStep

The patient at this mobility level has improved, although they will continue to address their deficits; whether it is increased levels of fatigue, compromised strength or increased rigidity. The patient is ambulatory but may exhibit less than optimal endurance and isolated muscle control. The BioStep, medBike and Sit2Stand are ideal for patients who remain weak, deconditioned or have poor coordination due to poor volitional motor patterns.

Recommendations

- Vitals to be monitored by clinician.
- Borg CR10 scale to be used to monitor exertion levels – maintain levels between 4 and 6.
- Based on clinical presentation and monitoring vitals of the patient, the therapist uses clinical judgement as to when to request increased RPMs.
- Recommend total duration is ten minutes with a perceived exertion not to exceed level 4-6. Recommendations may be varied based on patient reports of fatigue and therapist's clinical judgement.

medBike

The medBike can be used to improve endurance, strength and range of motion. Patients at this mobility level can tolerate longer intervals of training than patients that are profoundly involved, although intensity and duration should always be based on a patient's activity tolerance. The medBike allows for multiple levels of patients to safely exercise as there are variable modes, including: active, passive, and pedal assist.

Recommendations

- Patients should rate their perceived exertion from the Borg CR10 scale.
- Levels of perceived exertion should be at an optimal level of 4-6 exertion.
- Recommended initial trials of activity should be between 2-5 minutes each trial, clinical judgement should be made pertaining to the patient's HR/RR monitoring and the patient's subjective complaints.
- Modes can be interchanged between active, passive, and pedal assist dependent on patient's tolerance to the level.
- Patient's vitals should be assessed pre- and post-exercise.

Sit2Stand

The Biodex Sit2Stand can be used to assist in maintaining muscle strength and endurance. It can also assist in isolated muscle control. The sit-to-stand movement is the precursor to walking and function.

Recommendations

- Range of motion: 5-6 days per week, major muscle groups
- Endurance: 3-4 days per week, short rests, progressive workload increase
- Power training: 3-4 days per week, increase workload progressively
- Resistance Training: 2-3 days per week, slow speed

Balance System SD

Patients are utilizing all balance systems in this category of rehabilitation. Core stability, in addition to proprioception, vestibular and vision, are called upon to assist the patient to remain upright due to unexpected variables affecting stability levels.

Recommendations

- **Random Control Training** – Adjust target diameter, target speed and platform stability as tolerated.
- **Ball/Object Toss Activity** – Position patient on platform facing away from the display unit.
- **Reaching and Functional Activities** – Face patient away from display screen and have patient perform reaching activities. Modify location, weight, size or location of object and platform stability as tolerated.
- **Therapist Induced Perturbations** – Adjust platform stability to desired level in the Postural Stability Training mode. Therapist can induce unexpected perturbations by pushing gently on the patient's torso or using their foot to vary the platform. *Use a spotter or harness support for fall protection at all times during this task.*

Balance System SD and Vibrotactile Cueing

The Biodex VibroTactile System is an option for the Balance System SD to provide tactile cueing. This stimulus heightens somatosensory input to accommodate impaired regulation of equilibrium and postural control.

Recommendations

- **Postural Stability** - Finding center and working on internal control mechanism for automatic movement patterns. Increase target distance to increase movement excursion, cueing from vibration will assist with task completion.
- **Weight-Shift Training** - Addresses spatial and temporal relationships for improving postural control. Visual and tactile stimulus assist with movement in the M/L and A/P planes. Increase excursion of movement. Add diagonal patterns.
- **Limits of Stability** -Vibrotactile cueing will assist with movement patterns, inside and outside of the sway envelope.
- **Random Control** - Increase target speed. Vibratory input will create positive feedback loop.

Unweighing System and Gait Trainer 3

This category of neurological impairment addresses functional activity while still maintaining safety. Unweighing most likely will not be necessary for patients at this level. They will be supervised or independent on the Gait Trainer 3. Faciliatory techniques used as needed. Activities of focus will be performance of variable components of gait while maintaining upright and an aligned postural control. Step length can be altered to improve symmetry. Speed can be altered to address cadence. The patients can perform gait activities in variable planes of mobility. Reciprocal movement patterning can be addressed on the Gait Trainer.

Recommendations

- Introduce the patient to unsupported ambulation on the Gait Trainer.
- Introduce obstacles onto the Gait Trainer belt at SLOW SPEED.
- Incorporate changes in speed, direction and visual-field flow to simulate functional activities.
- Set gait speed goals.
- Vary step length to inhibit festinating gait patterns.

FreeStep SAS (Supported Ambulation System)

The advanced level of the neurological patient presents with overall improved function in balance and ambulation. They may continue to experience rigidity, uncoordinated muscular activity, range of motion deficits and other functional limitation. The FreeStep provides a safe environment for patients to participate in full weight-bearing activities while addressing functional activities but with a decreased fall risk. It assists with over ground activities and will relieve therapists to facilitate mobility and analyze movement patterns.

Recommendations

- Ball toss, reaching and functional activities to offset patient's dynamic balance.
- Turning activities can be incorporated into gait training to increase stability.
- Navigating various surfaces to assist with proprioception levels.
- Obstacle courses create a mock functional environment to assist with freezing patterns during change in services.
- Unilateral lower-extremity exercises when harnessed into the FreeStep will provide a safe environment to continue strengthening the involved extremity.
- Using a hi/low table, address developmental sequences to promote scapula, pelvic and core stability.
- Stair climbing for strength, coordination and endurance activities.

8. References

Sit-to-Stand Exercise Recommendations

Modality	Resistance Training	Power Training*	Range of Motion Training	Endurance Training
Frequency	· 2-3 days/wk	· 3-4 days/wk	· 5-6 days/wk · Major muscle groups	· 3-4 days/wk
Volume	· 1-3 sets; 8-12 reps · 1 minute rest between reps · 60%, 1 RM	· 3 sets	· Progressive as per patient tolerance	· 1-4 sets based on patient tolerance · 12-15 reps · 15-20 sec rest between reps
Intensity	· 5 on Borg CR10 Scale	· 6 on Borg CR10 Scale	· 3 on Borg CR10 Scale	· 5 on Borg CR10 Scale
	· 4-6 sec repetition · 50%, 1 RM	· Set 1-10 repetitions · 40% body-weight assist (BWA), with UE support · Set 2-10 repetitions · 25% VWA, same instructions without UE support · Set 3-10 repetitions · 40% VWA, same instructions with UE support	· 15 sec repetition	· 50%, 1 RM
Requirements for safety and maximal efficacy	· Slow speed · No ballistic movements · Day of rest between sessions · Good form without muscle substitutions · Decrease percent RM when poor form is noted	· Increase speed and intensity · Maintain controlled standing and sitting motions · Work through full range of motion · Follow guidelines for maximal efficacy	· Move slowly through available range of motion. · Hold at end range for 1-2 seconds for increased mobility	· 5 on Borg CR10 Scale · Shorter rest periods · Increase workload progressively to maintain relative intensity · Progress difficulty as tolerated

* This facilitates power, enables the patient to learn how to “jump-up” and generate more force in a functional task, and provides some success, which leads to dopamine release and enhanced expectancies.

Borg CR10 Scale

Scale	Scale Rating	Perceived Exertion	Note
0	Nothing at all		Subjects don't feel any exertion whatsoever, e.g., no muscle fatigue, no breathlessness or difficulties breathing.
0.3			
0.5	Extremely weak	Just noticeable	
0.7			
1	Very weak		Very light. As taking a short walk at your own pace.
1.5			
2	Weak	Light	
2.5			
3	Moderate		Is somewhat, but not especially hard. It feels good and not difficult to go on.
4			
5	Strong	Heavy	The work is hard and tiring, but continuing not terribly difficult. The effort and exertion is about half as intense as "maximal".
6			
7	Very Strong		Is quite strenuous. Subject can go on, but really has to push himself/herself, and are very tired.
8			
9			
10	Extremely Strong	Maximal	An extremely strenuous level. For most subjects this is the most strenuous exertion they have ever experienced.

Unified Parkinson's Disease Rating Scale (UPDRS)

The UPDRS is a rating tool to follow the longitudinal course of Parkinson's disease. It is made up of the 1) Mentation, Behavior, and Mood, 2) ADL and 3) Motor sections. These are evaluated by interview. Some sections require multiple grades assigned to each extremity. A total of 199 points are possible. 199 represents the worst (total) disability, 0 = no disability.

I. Mentation, Behavior, Mood

Intellectual Impairment

- 0. none
- 1. mild (consistent forgetfulness with partial recollection of events with no other difficulties)
- 2. moderate memory loss with disorientation and moderate difficulty handling complex problems
- 3. severe memory loss with disorientation to time and often place, severe impairment with problems
- 4. severe memory loss with orientation only to person, unable to make judgments or solve problems

Thought Disorder

- 0. none
- 1. vivid dreaming
- 2. "benign" hallucination with insight retained
- 3. occasional to frequent hallucination or delusions without insight, could interfere with daily activities
- 4. persistent hallucination, delusions, or florid psychosis

Depression

- 0. not present
- 1. periods of sadness or guilt greater than normal, never sustained for more than a few days or a week
- 2. sustained depression for >1 week
- 3. vegetative symptoms (insomnia, anorexia, abulia, weight loss)
- 4. vegetative symptoms with suicidality

Motivation/Initiative

- 0. normal
- 1. less assertive, more passive
- 2. loss of initiative or disinterest in elective activities
- 3. loss of initiative or disinterest in day to day (routine) activities
- 4. withdrawn, complete loss of motivation

II. Activities of Daily Living

Speech

0. normal
1. mildly affected, no difficulty being understood
2. moderately affected, may be asked to repeat
3. severely affected, frequently asked to repeat
4. unintelligible most of time

Salivation

0. normal
1. slight but noticeable increase, may have nighttime drooling
2. moderately excessive saliva, may have minimal drooling
3. marked drooling

Swallowing

0. normal
1. rare choking
2. occasional choking
3. requires soft food
4. requires NG tube or G-tube

Handwriting

0. normal
1. slightly small or slow
2. all words small but legible
3. severely affected, not all words legible
4. majority illegible

Cutting Food/Handing Utensils

0. normal
1. somewhat slow and clumsy but no help needed
2. can cut most foods, some help needed
3. food must be cut, but can feed self
4. needs to be fed

Dressing

0. normal
1. somewhat slow, no help needed
2. occasional help with buttons or arms in sleeves
3. considerable help required but can do some things independently
4. helpless

Hygiene

0. normal
1. somewhat slow, no help needed
2. needs help with shower or bath or very slow in hygienic care
3. requires assistance for washing, brushing teeth, toileting
4. helpless

Turning in Bed/ Adjusting Bed Clothes

0. normal
1. somewhat slow, no help needed
2. can turn alone or adjust sheets but with great difficulty
3. can initiate but not turn or adjust alone
4. helpless

Falling-Unrelated to Freezing

0. none
1. rare falls
2. occasional, less than one per day
3. average of once per day
4. >1 per day

Freezing When Walking

0. normal
1. rare, may have start hesitation
2. occasional falls from freezing
3. frequent freezing, occasional falls
4. frequent falls from freezing

Walking

0. normal
1. mild difficulty, may drag legs or decrease arm swing
2. moderate difficulty requires no assist
3. severe disturbance requires assistance
4. cannot walk at all, even with assist

Tremor

0. absent
1. slight and infrequent, not bothersome to patient
2. moderate, bothersome to patient
3. severe, interferes with many activities
4. marked, interferes with many activities

Sensory Complaints Related to Parkinsonism

- 0. none
- 1. occasionally has numbness, tingling, and mild aching
- 2. frequent, but not distressing
- 3. frequent, painful sensation
- 4. excruciating pain

III. Motor Exam

Speech

- 0. normal
- 1. slight loss of expression, diction, volume
- 2. monotone, slurred but understandable, moderately impaired
- 3. marked impairment, difficult to understand
- 4. unintelligible

Facial Expression

- 0. normal
- 1. slight hypomimia, could be poker face
- 2. slight but definite abnormal diminution in expression
- 3. moderate hypomimia, lips parted some of time
- 4. masked or fixed face, lips parted 1/4 of inch or more with complete loss of expression

Tremor at Rest

Face

- 0. absent
- 1. slight and infrequent
- 2. mild and present most of time
- 3. moderate and present most of time
- 4. marked and present most of time

Right Upper Extremity (RUE)

- 0. absent
- 1. slight and infrequent
- 2. mild and present most of time
- 3. moderate and present most of time
- 4. marked and present most of time

Left Upper Extremity (LUE)

- 0. absent
- 1. slight and infrequent
- 2. mild and present most of time
- 3. moderate and present most of time
- 4. marked and present most of time

Right Lower Extremity (RLE)

- 0. absent
- 1. slight and infrequent
- 2. mild and present most of time
- 3. moderate and present most of time
- 4. marked and present most of time

Lower Left Extremity (LLE)

- 0. absent
- 1. slight and infrequent
- 2. mild and present most of time
- 3. moderate and present most of time
- 4. marked and present most of time

Action or Postural Tremor**Right Upper Extremity (RUE)**

- 1. absent
- 2. slight, present with action
- 3. moderate, present with action
- 4. moderate, present with action and posture holding
- 5. marked, interferes with feeding

Left Upper Extremity (LUE)

- 0. absent
- 1. slight, present with action
- 2. moderate, present with action
- 3. moderate, present with action and posture holding
- 4. marked, interferes with feeding

Rigidity**Neck**

- 0. absent
- 1. slight or only with activation
- 2. mild/moderate
- 3. marked, full range of motion
- 4. severe

Right Upper Extremity (RUE)

0. absent
1. slight or only with activation
2. mild/moderate
3. marked, full range of motion
4. severe

Left Upper Extremity (LUE)

0. absent
1. slight or only with activation
2. mild/moderate
3. marked, full range of motion
4. severe

Right Lower Extremity (RLE)

0. absent
1. slight or only with activation
2. mild/moderate
3. marked, full range of motion
4. severe

Lower Left Extremity (LLE)

0. absent
1. slight or only with activation
2. mild/moderate
3. marked, full range of motion
4. severe

Finger taps**Right**

0. normal
1. mild slowing, and/or reduction in amplitude
2. moderately impaired, definite and early fatiguing, may have occasional arrests
3. severely impaired, frequent hesitations and arrests.
4. can barely perform

Left

0. normal
1. mild slowing, and/or reduction in amplitude
2. moderately impaired, definite and early fatiguing, may have occasional arrests.
3. severely impaired, frequent hesitations and arrests.
4. can barely perform

Hand Movements (open and close hands in rapid succession)

Right

0. normal
1. mild slowing, and/or reduction in amplitude
2. moderately impaired, definite and early fatiguing, may have occasional arrests
3. severely impaired, frequent hesitations and arrests
4. can barely perform

Left

0. normal
1. mild slowing, and/or reduction in amplitude
2. moderately impaired, definite and early fatiguing, may have occasional arrests
3. severely impaired, frequent hesitations and arrests
4. can barely perform

Rapid Alternating Movements (pronate and supinate hands)

Right

0. normal
1. mild slowing, and/or reduction in amplitude
2. moderately impaired. Definite and early fatiguing; may have occasional arrests
3. severely impaired, frequent hesitations and arrests
4. can barely perform

Left

0. normal
1. mild slowing, and/or reduction in amplitude
2. moderately impaired, definite and early fatiguing, may have occasional arrests
3. severely impaired, frequent hesitations and arrests
4. can barely perform

Leg Agility (tap heel on ground, amp should be 3 inches)

Right

0. normal
1. mild slowing, and/or reduction in amplitude
2. moderately impaired, definite and early fatiguing, may have occasional arrests
3. severely impaired, frequent hesitations and arrests
4. can barely perform

Left

0. normal
1. mild slowing, and/or reduction in amplitude
2. moderately impaired, definite and early fatiguing, may have occasional arrests
3. severely impaired, frequent hesitations and arrests
4. can barely perform

Arising From Chair (patient arises with arms folded across chest)

0. normal
1. slow, may need more than one attempt
2. pushes up from arms or seat
3. tends to fall back, may need multiple tries but can arise without assistance
4. unable to arise without help

Posture

0. normal erect
1. slightly stooped, could be normal for older person
2. definitely abnormal, moderately stooped, may lean to one side
3. severely stooped with kyphosis
4. marked flexion with extreme abnormality of posture

Gait

0. normal
1. walks slowly, may shuffle with short steps, no festination or propulsion
2. walks with difficulty, little or no assistance, some festination, short steps or propulsion
3. severe disturbance, frequent assistance
4. cannot walk

Postural Stability (retropulsion test)

0. normal
1. recovers unaided
2. would fall if not caught
3. falls spontaneously
4. unable to stand

Body Bradykinesia/Hypokinesia

0. none
1. minimal slowness, could be normal, deliberate character
2. mild slowness and poverty of movement, definitely abnormal, or decreased amplitude of movement
3. moderate slowness, poverty, or small amplitude
4. marked slowness, poverty, or amplitude

Impairment-Specific Quick Tips

Parkinson's Disease

Parkinson's disease is a motor system disorder. The cause for the disorder is a result of the loss of dopamine-producing cells within the brain. The primary symptoms of Parkinson's disease are tremors seen in the arms, legs or face, rigidity, or stiffness of the limbs and trunk; bradykinesia, or slowness of movement and postural instability, or impaired balance and coordination. Patients may have difficulty walking. Early symptoms of Parkinson's disease are subtle and occur gradually. As the disease progresses, the symptoms usually become more pronounced with increased gait disorders, poor movement initiation, and balance and coordination problems:

BALANCE TRAINING			
Impairment	Effect on Gait	Testing	Treatment
↓ LE muscle strength, distal > proximal	↓ ability to use ankle strategies effectively	Balance System SD: Postural Stability and Limits of Stability	Sit2Stand: Endurance and Resistance Training
	↓ weight-shift ability		Balance System SD: Progress as tolerated through the training modes in order of difficulty. Postural Stability or Percent Weight Bearing→Weight Shift Training→Limits of Stability→Maze Control→Random Control Training
	↓ ability to take rapid steps		Balance System SD and VibroTactile: Postural Stability / Weight-Shift Training
			FreeStep SAS: Reaching, ball toss, rapid stepping and turning in safety harness System 4: Ankle, knee and hip strength training
↓ LE proprioception distal > proximal	↓ balance especially when vision is compromised and on compliant surfaces	Balance System SD: mCTSIB	Balance System SD: Postural Stability Training with vision reduced, add head movement and ↓ platform stability or add foam as tolerated Balance System SD and VibroTactile: mCTSIB, Postural Stability FreeStep SAS: Over ground walking on unstable surfaces, balance and gait activities with vision reduced
Hypokinesia	↓ walking distance and community ambulation	Balance System SD: Limits of Stability and Weight Shifting Gait Trainer 3/RTM600 Treadmill: 2- or 6-minute walk test	BioStep/medBike: Build whole body endurance and/or use for patients not appropriate for treadmill training Gait Trainer 3/RTM600 Treadmill: Increase time and speed while maintaining appropriate cardiovascular training parameters FreeStep SAS: Walking

GAIT TRAINING			
Impairment	Effect on Gait	Testing	Treatment
↓ Postural Control	↓ step length	Gait Trainer 3/RTM600 Treadmill: Gait Trainer Summary Report	Balance System SD: Postural Stability, Weight Shifting and Limits of Stability to address core stability
	↓ push-off	System 4: Ankle, knee and hip testing	Sit2Stand: Endurance and Resistance Training
	↓ toe-clearance		Gait Trainer 3/RTM600 Treadmill: Gait training with visual and audio feedback for step length, step speed and symmetry
	↓ speed		System 4: Ankle, knee and hip strength training
↓ LE Proprioception	base of support	Gait Trainer 3/RTM600 Treadmill: Gait Trainer Summary Report	Gait Trainer 3/RTM600 Treadmill: Gait training with visual feedback for step length, symmetry and speed
	↑ double support time		Unweighing System w/Treadmill: Use Unweighing System for safety during gait activities with vision reduced or altered surfaces
	↓ walking ability when vision reduced		FreeStep SAS: Over ground walking on unstable surfaces and gait activities with vision reduced
Hypokinesia	↓ walking distance and community ambulation	Gait Trainer 3/RTM600 Treadmill: 2- or 6-minute walk test	BioStep/medBike: Build whole body endurance and/or use for patients not appropriate for treadmill training Gait Trainer 3/RTM600 Treadmill: Increase time and speed while maintaining appropriate cardiovascular training parameters FreeStep SAS: Walking, multiplane activities, various surface
Akinesia	↓ step length	Gait Trainer 3/RTM600 Treadmill: Gait Trainer Summary Report	Biodex Balance SD/VibroTactile: Postural Stability, Weight-Shift Training, Limits of Stability, Random Control
	↓ push-off	System 4: Ankle, knee and hip testing	Gait Trainer 3/RTM600 Treadmill: Gait training with visual and auditory feedback for step length, symmetry and speed
	↓ toe-clearance		
	↓ speed		System 4: Ankle, knee and hip strength training

9. Terminology

- Akinesia
- Dyskinesia
- Tremors
- Dysphagia
- Rigidity
- Retropulsive
- Festinating
- Dysphagia
- Esophageal dysphagia
- Weight loss
- Thermoregulation
- Hyperhidrosis
- Remediation
- Compensatory
- Direct Interventions
- Technology Assisted Interventions
- Impairment
- Disability
- Level of Neurological Impairment
- Postural Control
- Postural Stability
- Synergies
- Isolated movement patterns
- Activities of daily living (ADLs)

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