

"The Clinical Advantage"™



Parkinson's Disease

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

Authors:

Natalie Thompson, PT

Dave Wilcox, OTR/L

Kurt Jackson, PT, PHD, GCS



BIODEX

Biodesx Medical Systems, Inc.

20 Ramsey Road, Shirley, New York, 11967-4704, Tel: 800-224-6339 (Int'l 631-924-9000), Fax: 631-924-9338, Email: info@biodesx.com, www.biodesx.com

About the Authors

Natalie Thompson, PT

Natalie Thompson is a 1992 graduate of SUNY at Stony Brook with a dual degree in Biology and Physical Therapy. She has a background in clinical, managerial and educational settings. Natalie has practiced for ten years in orthopedics with specialized training from the McKenzie Institute and Institute of Physical Art. Since 2001, she has focused on working with neurologically impaired patients. Natalie was a hands-on manager for United Cerebral Palsy for six years, after which she began treating young children up to five years of age. She was an adjunct Teaching Assistant for Stony Brook University in the Physical Therapy program. Currently, Natalie works for Biodex as a Clinical Administrator and Applied Clinician. She remains a part time treating clinician and consultant working with children up to three years of age.

David Wilcox, OTR/L

David Wilcox, OTR/L is an experienced clinician that has worked in the field of Occupational Therapy for 18 years. David started his career in 1998 at Moss Rehabilitation Hospital in Philadelphia treating an array of diagnoses such as traumatic brain injury, stroke, spinal cord injury, cardiac, pulmonary, and orthopedic conditions. He expanded his role from treating clinician to student supervisor, guest lecturer, mentor, and adjunct professor with specific focus on neuroscience and cognition.

David has been associated with Biodex since 2010, and recently joined the team in a full-time role. As a clinical educator, he provides operational in-services, continuing education accredited courses and workshops, and ongoing clinical support for Biodex's line of physical medicine and rehabilitation products.

Kurt Jackson PT, PhD, GCS

Kurt is the neurology coordinator at the University of Dayton's Doctor of Physical Therapy Program. He has published numerous scientific studies on the topic of balance and gait in individuals with neurological disorders. Kurt has also written several book chapters on the subject of exercise in the management of chronic neurological disorders. He has presented locally and nationally on the rehabilitation of individuals with multiple sclerosis, stroke, Parkinson's disease and peripheral neuropathy.

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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 are 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, more than 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. Healthcare 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 healthcare 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 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; the disease process is chronic and progressive in nature. The rate of progression varies from person-to-person as do 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 21 years old. 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.

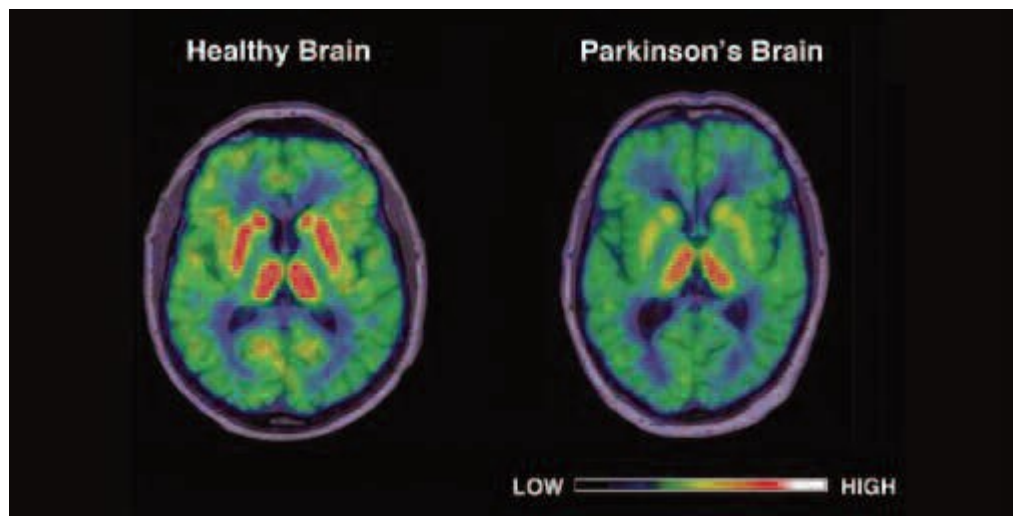


Figure 3.1 Brain with and without Parkinson's disease

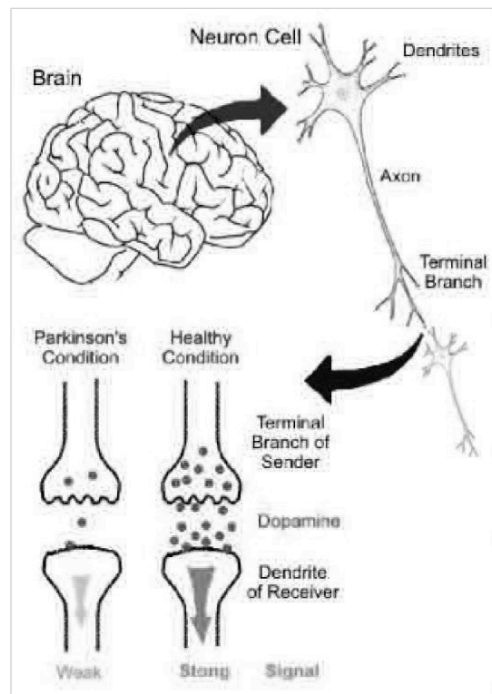


Figure 3.2. *Physiology of Dopamine*

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.

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 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 that 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 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.
- **Hyperkinesia:** 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
- Vision and dental problems
- Fatigue and loss of energy
- Depression
- Fear and anxiety
- Skin problems
- Sleep disturbances
- Thought alterations
- Sensory disturbances

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

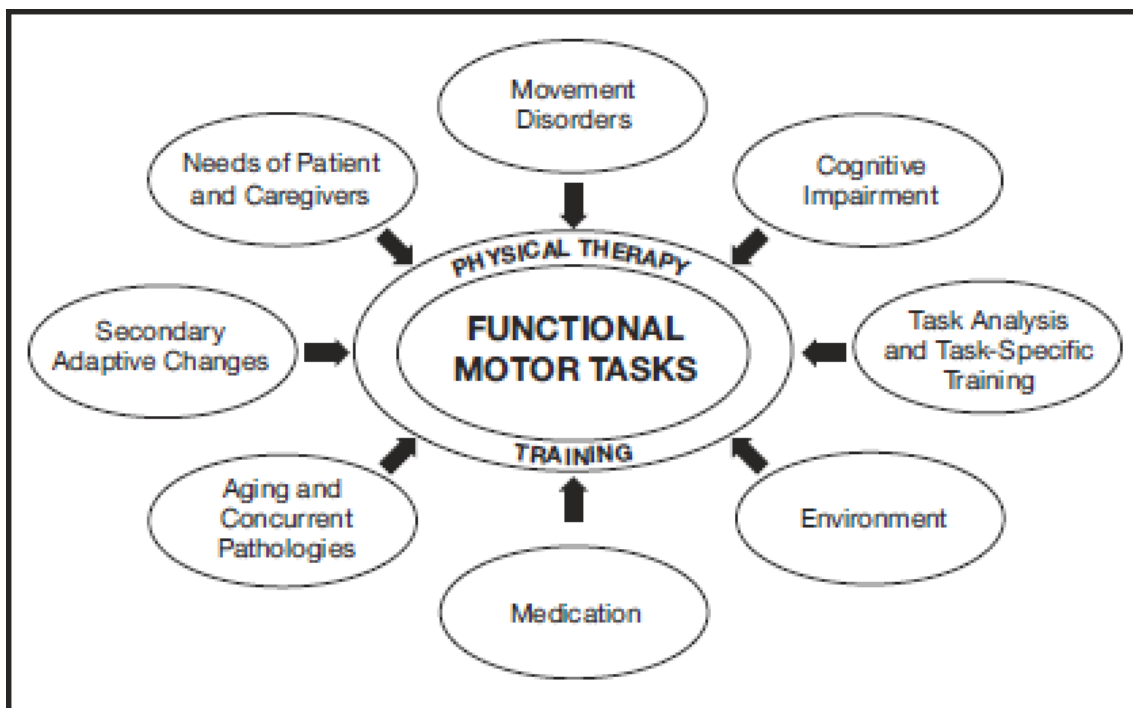


Figure 4.1. Functional Motor Tasks

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, hyperkinesia, 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 the 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 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 healthcare 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
- VibroTactile™ System
- BioSway™
- BioStep™ 2 Semi Recumbent Elliptical
- Sit2Stand Squat-Assist Trainer™
- Gait Trainer™ 3
- NxStep™
- FreeStep SAS
- System 4 Dynamometer
- medBike®

5. Fall Risk for Parkinson's Disease

In upright standing, many individuals with Parkinson's disease have reduced postural sway due to hyperkinesia (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 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 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

Table 5.1. Fall Risk Screening Test Table

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 optional 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 assist 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

Table 6.1. 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, and 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, but 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, but 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 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 that requires 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.

Applicable for Profound Neurological Impairment.

Activities – Postural Control

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 in sitting with assist and identifying their midline as well as attempts at standing. They are generally becoming familiar with placing weight through their lower extremities and finding their center of gravity in standing. To assist with standing activities, the use of the Biodex NxStep will help to ensure safety against falls.

NxStep/Gait Trainer

The patients at this mobility level either cannot stand or may require maximal assistance to stand. They have poor endurance. Once the harness is donned (see the NxStep manual for specific donning and doffing instructions), the NxStep 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, utilization of the NxStep will work 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 initially for a specified period of time or based on the patient's tolerance.
- Therapist examines and assesses the patient during the baseline ambulation trial, when applicable, based on each specific patient's goals and motor ability.
- If vitals are unstable and/or the patient is not feeling well, the clinician should take the necessary steps to assure patient safety.
- When applicable and based on the 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.

Applicable for Moderate and Minimal Neurological Impairment.

Activities – Dynamic Weight Shifting

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 NxStep and Gait Trainer, patients can walk short distances.

BioStep

The BioStep can be used to improve tolerance to activity, improve endurance, and assist with range of motion and reciprocal movement patterns/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 Squat-Assist Trainer

The 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 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 the sway envelope.
- **Weight-Shift Training** - Addresses spatial and temporal relationships for improving postural control. Visual and tactile stimuli assist with movement in the M/L and A/P planes.
- **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.

NxStep Unweighing System and Gait Trainer

The patient may tolerate treadmill training time via unweighing up to 40 percent of body weight utilizing the system. This will help to improve postural control (see the NxStep manual on how to safely utilize the system harness, determine percent of offloading and navigate through Gait Trainer operations). The Gait Trainer provides audio cueing 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 NxStep can be used for pre-gait activities, weight shifting, working on average step length, step length variability, and time spent on each foot. This will assist with 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 various objective walk tests. Typically these will be 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.

NxStep Unweighing System and Gait Trainer/ Music-Assisted Therapy

This treatment is for patients with movement disorders. The patient may tolerate training time using the NxStep when in need to offset body weight due to fatigue, lack of muscular control, or for general safety (see the NxStep manual on how to safely utilize the system harness, determine percent of offloading and navigate through Gait Trainer operations). Higher-level patients can work on the Gait Trainer without the use of the NxStep. The Gait Trainer 3 will help patients by providing audio cueing and visual biofeedback assisting with gait impairments due to specific diagnoses. Patients specifically diagnosed with Parkinson's disease, Cerebrovascular Accident, Muscular Sclerosis, and Cerebral Palsy will benefit from additional auditory stimulus — music. Music helps to regulate gait and timing via the connection between the auditory and motor circuits in the brain.

Prior to working with the Gait Trainer 3/Music-Assisted Therapy it is imperative to perform a gait analysis and determine the patient's steps per minute. Typically the gait assessment is performed over ground although some therapists may prefer to analyze gait patterns and gait speed on the Gait Trainer. Variations in evaluative techniques are based on each therapist's preference.

Gait training can begin once the patient's gait speed and impairments have been determined (see the Rehab Plan called Strategies to Improve Functional Movement Using Music for the Gait Trainer at www.biodex.com/rrp.gtmat to perform music-assisted therapy step-by-step).

Recommendations

- Introduce the patient to utilization of the Gait Trainer and to Music Therapy.
- Evaluate for specific gait impairments.
- Incorporate changes in gait speed using Rhythmic Auditory Cueing, which will assist to regulate a patient's internal timing.
- Vary gait speed to assist patients in improving their gait parameters; such as step length and time spent on each foot. Improving these parameters will assist to inhibit festinating gait patterns.

Applicable to Supervised and Supervised-Independent Neurological Impairment.

Activities - Reactive Postural Control Training

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 during multitask performance. Patients at this independent level can work on improving their levels utilizing the BioStep. They can address lower-extremity strength on the Sit2Stand. Patients training on the NxStep/Gait Trainer can 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: To participate in cardiovascular activities, the patient must be medically stable and receive clearance from the physician.

BioStep

At this mobility level, the patient has improved, but must continue to address deficits such as 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.
- Recommended 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 Squat-Assist Trainer

The 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 sensory and motor 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 stimuli assist with movement in the M/L and A/P planes, increase excursion of movement, and 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.

NxStep Unweighing System and Gait Trainer

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. Facilitatory techniques are used as needed. Activities of focus will be on performance and the variable components of gait while maintaining upright and 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.

NxStep Unweighing System and Gait Trainer/ Music-Assisted Therapy

This treatment is for patients with movement disorders. The patient may tolerate training time using the NxStep when in need to offset body weight due to fatigue, lack of muscular control or for general safety (see the NxStep manual on how to safely utilize the system harness, determine percent of offloading, and navigate through Gait Trainer operations). Higher-level patients can work on the Biodex Gait Trainer without the use of the NxStep. The GT will help patients by providing audio and visual biofeedback assisting with gait impairments due specific diagnoses. Patients specifically diagnosed with Parkinson's disease, Cerebrovascular Accident, Muscular Sclerosis, and Cerebral Palsy will benefit from additional auditory stimulus — music. Music helps to regulate gait and timing via the connection between the auditory and motor circuits in the brain.

Prior to working with the Gait Trainer and the Music-Assisted Therapy package it is imperative to perform a gait analysis and determine the patient's steps per minute (SPM). Typically, the gait assessment is performed over ground although some therapists may prefer to analyze gait patterns and gait speed on the Gait Trainer. Variations in evaluative techniques are based on each therapist's preference.

Gait training can begin once the patient's gait speed and impairments have been determined (see the Rehab Plan called Strategies to Improve Functional Movement Using Music for the Gait Trainer 3 to perform Music-Assisted Therapy step-by-step).

Recommendations

- Introduce the patient to utilization of the Gait Trainer and to Music Therapy.
- Evaluate for specific gait impairments.
- Incorporate changes in gait speed using a Rhythmic Auditory Cueing (RAC) that helps to regulate a patient's internal timing.
- Vary gait speed to assist patients in improving their gait parameters; such as step length and time spent on each foot. Improving these parameters will assist 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

Table 8.1. Sit-to-Stand Exercise Time Table

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

Table 8.2. 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			
	Very weak		Very light. As taking a short walk at your own pace.
1.5			
2	Weak	Light	
2.5			
	Moderate		Is somewhat, but not especially hard. It feels good and not difficult to go on.
4			
	Strong	Heavy	The work is hard and tiring, but continuing not terribly difficult. The effort and exertion is about half as intense as "maximal".
5			
6			
	Very Strong		Is quite strenuous. Subject can go on, but really has to push himself/herself, and are very tired.
7			
8			
9			
	Extremely Strong	Maximal	An extremely strenuous level. For most subjects this is the most strenuous exertion they have ever experienced.
10			

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, which 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.

NOTE: *The complete Unified Parkinson's Disease Rating Scale can be viewed using the following url: <http://www.theracycle.com/pd/parkinsons-updrs-scale.aspx>.*

Diagnosis Specific Testing and Treatment Guide

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:

Table 8.3. Testing and Treatment

BALANCE TRAINING			
Impairment	Effect on Balance	Testing	Treatment
<p>↓ LE muscle strength, distal>proximal</p>	<p>↓ Ability to use ankle strategies effectively</p> <p>↓ Weight-shifting ability</p> <p>Fatigue</p>	<p>Balance System SD/BioSway: Postural Stability and Limits of Stability</p> <p>Use Fall Risk Test to determine risk of falling</p> <p>System 4: Ankle, knee and hip strength testing</p>	<p>Balance System SD/BioSway: Progress as tolerated through the training modes in order of difficulty. Postural Stability or Weight Shift Training → Percent Weight Bearing→Motor Control →Maze Control→Random Control training</p> <p>Balance System SD/BioSway and VibroTactile: Postural Stability/Weight-Shift Training</p> <p>System 4: Ankle, knee and hip strength training</p> <p>BioStep/medBike: Build whole body endurance, work on reciprocal movement patterns.</p> <p>Sit2Stand/Squat Assist: Endurance and Resistance Training</p> <p>FreeStep SAS: Reaching, ball toss, rapid stepping and turning in safety harness.</p>
<p>↓ LE Proprioception distal > proximal</p>	<p>↓ Balance especially when vision is compromised and standing on uneven surfaces.</p>	<p>Balance System SD/BioSway: mCTSIB</p>	<p>Balance System SD/BioSway and VibroTactile: Postural Stability/ Weight Shifting Training, Motor control training/Random Control training.</p> <p>FreeStep SAS: Standing Balance activities. Over ground walking on stable with progression to unstable surfaces, and gait activities with vision reduced.</p>

BALANCE TRAINING			
Impairment	Effect on Balance	Testing	Treatment
↓ Postural Control	Poor Balance Unable to move out of COG Fatigue	Balance System SD/BioSway: Postural Stability, weight shifting , limits of stability Perform Fall risk test System 4: Ankle, knee and hip strength testing	Balance System SD: Postural Stability, Weight Shifting, and Limits of Stability to address core stability. Sit2Stand Squat Assist : Endurance and Resistance Training FreeStep SAS: Standing activities. Over ground walking on stable with progression to unstable surfaces, and gait activities with vision reduced.

GAIT TRAINING			
Impairment	Effect on Balance	Testing	Treatment
Hyperkinesia	<p>↓ poor weight shifting ability,</p> <p>poor ability to produce movement</p> <p>rigid movement without fluidity, unable to move out of COG</p>	<p>Gait Trainer 3/Music-Assisted Therapy: Gait evaluation and determine spm, stride length</p>	<p>BioStep/medBike: Build whole body endurance, work on reciprocal movement patterns and/or use for patients not appropriate for treadmill training.</p> <p>Gait Trainer 3/Music-Assisted Therapy: FreeStep SAS: Walking, multiplane activities, various surfaces</p> <p>Gait Trainer 3/Music-Assisted Therapy: Have patient entrain to regulate internal timing.</p> <p>RAC: Used for regulation of cadence time, address deficits such as gait velocity, steps per minute and step length.</p> <p>FreeStep SAS: Standing with a progression for weight shifting ant/post/lat, ball toss, walking, walking and turning.</p>
Akinesia (loss of voluntary movement)	<p>Unable to initiate movement.</p> <p>Fog</p> <p>Range of motion/strength</p>	<p>Gait Trainer 3/Music-Assisted Therapy:</p> <p>Gait Trainer Summary Report</p> <p>System 4: Ankle, knee and hip testing.</p>	<p>Biodex Balance SD/VibroTactile: Postural Stability, Weight-Shift Training, Limits of Stability, Random Control.</p> <p>Gait Trainer 3/Music-Assisted Therapy: Gait training with visual and auditory feedback for step length, symmetry and cadence. Have patient entrain prior to gait training for regulation of their internal timing.</p> <p>BioStep/medBike: Build whole body endurance and/or use for patients not appropriate for treadmill training.</p> <p>System 4: Ankle, knee and hip strength training.</p>

GAIT TRAINING			
Impairment	Effect on Balance	Testing	Treatment
↓ Postural Control	↓ push-off ↓ toe-clearance ↓ speed	System 4: Ankle, knee and hip testing Determine fall risk. Gait Trainer 3/:Music-Assisted Therapy: Gait training with visual and audio feedback for monitoring step length, step speed and symmetry.	Gait Trainer 3/Music-Assisted Therapy Rhythmic Auditory Cueing Balance System SD: Postural Stability, Weight Shifting, and Limits of Stability to address core stability. Sit2Stand Squat-Assisted Trainer: Endurance and Resistance Training 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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Biodex Medical Systems, Inc.

20 Ramsey Road, Shirley, New York, 11967-4704, Tel: 800-224-6339 (*Int'l 631-924-9000*), Fax: 631-924-9338, Email: info@biodex.com, www.biodex.com

