ACSM (2021) Parkinson's (PD) Guidelines & Recommendations.

Introduction

Parkinson's disease (PD) is the second most common neurodegenerative disease after Alzheimer's disease, and it is estimated that nearly 700,000 individuals in the United States age 45 yr. and older are living with PD, with this number projected to double by 2030. It is uncommon for PD to be diagnosed before 50 yr. of age, but the incidence increases 5- to 10-fold from ages 60 to 90 yr. The global estimate of PD prevalence is currently 6.1 million individuals. PD is a chronic, progressive neurological disorder characterized by signs of bradykinesia, resting tremor, rigidity, postural instability, and gait abnormalities. PD is a form of parkinsonism, a clinical syndrome including other neurodegenerative parkinsonian disorders, such as multiple systems atrophy, progressive supranuclear palsy, and corticobasal degeneration. They are collectively referred to as atypical parkinsonian disorders and have similar core features yet varying clinical signs that lead to differential diagnoses. The motor features of PD are the result of degeneration of the dopaminergic nigrostriatal pathway of the midbrain, which results in a reduction in the neurotransmitter dopamine in the striatum. The cause of PD is unknown; however, aging, genetic susceptibility, and environmental factors likely all play a role. Inflammation and mitochondrial dysfunction may also contribute to the disease process.

Table 1. Common Movement Disorders in Individuals with Parkinson's Disease.

Bradykinesia	Reduced movement speed and amplitude; at the extreme, it is known as hypokinesia, which refers to "poverty" of movement.
Akinesia	Difficulty initiating movements
Episodes of freezing	Motor blocks/sudden inability to move during the execution of a movement sequence
Impaired balance and postural instability	Difficulty maintaining upright stance with narrow base of support in response to a perturbation to the centre of mass or with eyes closed; difficulty maintaining stability in sitting or when transferring from one position to another; can manifest as frequent falling
Dyskinesia	Over reactivity of muscles, can manifest as dystonia; wriggling/writhing movements; chorea or rarely athetosis
Tremor	Usually resting tremor; more rarely postural or action tremor
Rigidity	Hypertonicity and hyperreflexia in agonist and antagonist muscle groups in each limb
Adaptive responses	Reduced activity, muscle weakness, reduced muscle length, contractures, deformity, reduced aerobic capacity

The progression of the stages of the disease is described by the Hoehn and Yahr (HY) scale (**Table 2**). The key point to notice in the HY scale is that people in stages 1–2 do not have postural instability.

Table 2. The Hoehn and Yahr Staging Scale of Parkinson's Disease.

Stage 1 = Unilateral involvement only, usually with minimal or no functional impairment
Stage 2 = Bilateral or midline involvement, without impairment of balance
Stage 3 = First sign of impaired righting reflexes. This is evident by unsteadiness as the individual turns or is demonstrated when pushed from standing equilibrium with the feet together and eyes closed. Functionally, this person is somewhat restricted in activities but may have some work potential depending on the type of employment. Individuals are physically capable of leading independent lives, and their disability is mild to moderate
Stage 4 = Fully developed, severely disabling disease; the person is still able to walk and stand unassisted but is markedly incapacitated
Stage 5 = Confinement to bed or wheelchair unless aided

The standard clinical scale for assessing PD is the Movement Disorder Society Unified Parkinson's Disease Rating Scale (MDS-UPDRS). The MDS-UPDRS is a valid and reliable comprehensive clinical rating scale used to monitor the burden and extent of PD. The MDS-UPDRS consists of 65 items and covers four different domains: Part I assesses the nonmotor experiences of daily living such as cognition, depression, sleep, fatigue, and hallucinations; part II assesses the individual's perception of their ability to engage in ADL such as eating, dressing, hobbies, and walking; part III covers the motor evaluation, which includes ratings for rigidity (stiff ness), bradykinesia (slowness), gait, postural stability, and tremor; and part IV assesses the motor complications including ratings for dyskinesias (involuntary movements), dystonia (painful cramps), and motor fluctuations (irregular responses to PD medication). Each item is rated on a 0–4 scale (0 = normal; 1 = slight; 2 = mild; 3 = moderate; 4 = severe), with higher scores indicating a greater impact of PD symptoms. Individuals with PD may have difficulty performing ADL and suffer from reduced quality of life. The primary feature of PD is bradykinesia, which refers to slowness in movement and reduced movement amplitude. It is characterized by a fatiguing and decrement of fast movements such as finger tapping. Clinically, it causes a reduction in dexterity manifest by micrographia, reduced arm swing, and difficulty with fine motor tasks.

Resting tremor is present in some individuals with PD and is typically a larger amplitude, rhythmic shaking of the distal limbs, most commonly occurring in the hand or arm. Usually, it is asymmetric and can be suppressed by voluntary activity, sleep, and complete relaxation of axial muscles. Stress and anxiety increase resting tremor. Rigidity is an increase in tone, often with a ratchet- like quality called cogwheeling, which can lead to an increase in the individual's perception of movement effort and may be related to feelings of fatigue. These three signs of the disease (microphagia, reduced arm swing, difficulty with fine motor tasks) can occur in HY stages 1–2.

Postural instability refers to "the impairment in balance that compromises the ability to maintain or change posture such as standing and walking". This is a feature of more advanced stages of the disease (HY stages 3–5) and can lead to falls. Individuals with more advanced PD may have a stooped posture (rounded shoulders, forward head, increased flexion of the trunk and knees) and a reduced stride length when walking such that the gait appears to be shuffling, with decreased arm swing, and may have poorer walking economy when compared to persons without PD. Difficulty and slowness in performing turns, getting up, transfers, and ADL are common as PD advances. Other problems include excessive salivation or drooling; soft, slurred speech; and a variety of nonmotor features, including cognitive impairment, mood disorders, and sleep disorders that impact quality of life. Individuals with PD also suffer from autonomic nervous system dysfunction including cardiovascular dysfunction, especially in advanced stages. Autonomic dysfunction in PD may result in orthostatic hypotension, cardiac arrhythmias, sweating disturbances, and urinary problems.

It is important to note that people may have had PD for several years before they are given the diagnosis of the disease. This is referred to as the prodromal stage of the disease and is characterized by rapid eye movement sleep disorder, constipation, depression, loss of smell (hyposmia), anxiety, and excessive daytime sleepiness. Exercise can help all these symptoms, which can precede the disease by many years.

Treatment of PD is complex due to the progressive nature of the disease, the vast range of motor and nonmotor symptoms, and the different side effects associated with therapeutic interventions. One key point about the disease is that it is relentlessly

progressive. Different signs and symptoms progress at different rates, and progression is often fastest early in the disease. The progression of the motor signs can be as much as 3–6 points per year or more when measured by the Unified Parkinson's Disease Rating Scale. Treatments include drug therapy, surgery, physical rehabilitation, and exercise programming. With respect to drug therapy, levodopa is a dopamine precursor that is converted to dopamine in the brain. Carbidopa is added to levodopa to prevent the breakdown of levodopa in the blood, allowing the maximum amount of medication to get to the brain while limiting potential adverse effects caused by dopamine in the body, such as nausea and vomiting. Levodopa + carbidopa is the most prescribed class of drug for the management of PD and is the single most effective drug available to treat all cardinal features of PD, except for rest tremor. As PD progresses, the effect of levodopa may wane.

Long-term use is associated with motor complications including motor fluctuations and dyskinesias in about 50% of individuals within 5 yr. Other side effects include nausea, sedation, orthostatic hypotension, and psychiatric symptoms such as hallucinations, confusion, and paranoia. Other medications that are used to treat PD symptoms are illustrated in Table 3. These drugs may be used as a monotherapy or adjunct therapy to provide symptomatic relief in PD and may have side effects that are important to consider when prescribing exercise to those with PD. Exercise professionals working with individuals with PD are advised to become familiar with these medications.

Individuals with advanced PD whose motor complications are inadequately managed with medication may choose to undergo deep brain stimulation (DBS). DBS stimulates the brain at high frequencies and thus replaces abnormal high and variable neuronal firing with a consistent pattern. DBS is more effective than drug therapy in advanced PD in reducing dyskinesias, improving motor function, and increasing quality of life.

Table 3. Common Medications for Treatment of Motor Symptoms of Parkinson's Disease.

Medication Class	Medication Name	Adverse Effects	Indication
Levodopa-PDDI	Levodopa-carbidopa Levodopa-benserazide	Nausea, orthostatic hypotension, dyskinesia, hallucinations	All motor symptoms
Dopamine agonists	Pramipexole Ropinirole Rotigotine	Nausea, orthostatic hypotension, hallucinations, ICDs, oedema, increased sleepiness	All motor symptoms
MAOBIs	Selegiline	Stimulant effect, dizziness, headache, confusion, exacerbation of levodopa adverse effects	Early, mild symptoms, and motor fluctuations
	Rasagiline	Headache, arthralgia, dyspepsia, depression, flulike syndrome, exacerbation of levodopa adverse effects, constipation	
COMTIs	Entacapone	Dark-coloured urine, exacerbation of levodopa adverse effects	Motor fluctuations
	Tolcapone	Dark-coloured urine, exacerbation of levodopa adverse effects, hepatotoxicity	
Unspecified	Amantadine	Hallucinations, confusion, blurred vision, ankle oedema, livedo reticularis, nausea, dry mouth, constipation	Gait dysfunction dysjubesua
Anticholinergic	Trihexyphenidyl Benztropine	Hallucinations, cognitive impairment, nausea, dry mouth, blurred vision, urinary retention, constipation	Tremor

COMTIs, catechol-O-methyltransferase inhibitors; ICDs, impulse control disorders; MAOBIs, monoamine oxidase type B inhibitors; PDDI, peripheral dopa decarboxylase inhibitor.

Alongside drug therapy and surgery in the treatment and management of PD is exercise, which is a vital component of managing the signs and symptoms of the disease. Regular exercise will decrease or delay secondary sequelae affecting musculoskeletal and cardiorespiratory systems that occur because of reduced PA. Because PD is a chronic progressive disease, sustained exercise is necessary to maintain benefits. Evidence suggests that exercise can reduce disease severity and slow down the progression of the signs of the disease. Exercise also improves strength, aerobic capacity, gait performance, and quality of life in individuals with PD.

Exercise Testing

Exercise testing can be used to determine current fitness levels, physiological response to a given exercise bout, and any functional limitations prior to prescribing exercise so that the program can be specified to the individual's particular needs. Most individuals with PD have impaired mobility and problems with gait, balance, and functional ability, which vary from individual to individual. Many individuals with PD experience fluctuations of their motor symptoms from day to day, even from moment to moment. These fluctuations are sometimes attributed to the timing and dosage of their medication and can vary within the same individual and among different individuals. This is important to consider during exercise testing and programming, as the variability of motor fluctuations may influence testing outcomes and daily exercise performance. As an attempt to control for the variability in testing outcomes due to symptom fluctuations, and to help document accurate changes in performance, it may be helpful to utilize a graded symptom checklist on days of pre- and-post-testing. The impairments of PD are often accompanied by low levels of physical fitness (e.g., CRF, muscular strength and endurance, core stability, and flexibility).

There are several special considerations that should be considered prior to performing exercise testing for individuals with PD. Because many individuals with PD are older and have reduced PA levels, assessment of cardiovascular risk (may be warranted prior to beginning an exercise test. Autonomic nervous system dysfunction can occur with these individuals, thereby increasing the risk of developing BP abnormalities, which can be further affected by medications. Additionally, individuals with PD may experience orthostatic hypotension. The occurrence of orthostatic hypertension is directly related to the duration and severity of the disease and can also be induced by any of the dopaminergic drugs that are used to manage PD symptoms. Tests of balance, gait, general mobility, ROM, flexibility, muscular strength, core stability, and aerobic capacity are recommended before exercise testing is performed. Results of these tests can guide how to safely exercise test the individual with PD. Static and dynamic balance evaluation and physical limitations of the individual should be used in making decisions regarding testing modes for test validity and safety.

For individuals with PD, clinical balance tests include the functional reach test, Berg Balance Scale, Mini-BESTest, tandem stance, single limb stance, and pull tests. Functional mobility can be assessed with the Timed Up and Go test and chair sit-to-stand test. Gait observation can be done during the 10-m walk test at a comfortable walking speed. Meanwhile, strength can be evaluated by manual muscle testing, arm curl tests, RM assessment using weight machines, dynamometers, and chair rise tests just as it is in older adults. Flexibility can be assessed with goniometry, the sit-and-reach test, and the back-scratch test. Aerobic capacity can be assessed sub maximally with the 6-MWT.

Decisions regarding submaximal and maximal exercise testing protocols may be influenced by the stage of PD or physical limitations of the individual. Use of a cycle ergometer alone or combined with arm ergometry may be more suitable for individuals with severe gait and balance impairment or with a history of falls. However, use of leg/arm ergometers may preclude individuals with PD from achieving a maximum cardiorespiratory response because of early muscular fatigue before the maximal cardiorespiratory levels are attained. Treadmill protocols can be used safely in individuals with early-stage PD, or HY stage 1–2. Submaximal tests may be most appropriate in advanced cases (HY stage ≥3) or with severe mobility impairment. For individuals with very advanced PD (HY stage ≥4) and those unable to perform a GXT for various reasons, such as inability to stand without falling, severe stooped posture, and deconditioning, may require a radionuclide stress test or stress echocardiography. Moreover, for an individual who is deconditioned, demonstrates lower extremity weakness, or has a history of falling, care and precautions should be taken, especially at the final stages of the treadmill protocol when fatigue occurs, and the individual's walking may deteriorate. A gait belt should be worn, and a technician should stand by close to the subject to guard during the treadmill test. For people with advanced symptoms, symptom-limited exercise testing should be considered as an alternative to heart-rate limited exercise testing, although this recommendation may be modified in certain situations. Symptoms include but are not limited to fatigue, shortness of breath, abnormal BP responses, and signs of discomfort. The Borg RPE scale is a valid tool that can and should be utilized as an aid during exercise testing to monitor physical exertion levels and assess fatigue. Antiparkinsonian medication intake should be noted prior to performing the exercise test due to the individual's susceptibility to

experiencing orthostatic hypotension as a side effect of dopaminergic medication. If possible, GXT should be conducted when antiparkinsonian medication is at its peak effect. In addition, it is important to practice walking on a treadmill prior to testing and to use the modified Bruce protocol. Although the Bruce protocol is the most used protocol for exercise testing on a treadmill, this protocol may be too strenuous for some individuals with PD.

For individuals with DBS, the signal from the DBS pulse generator interferes with the ECG recording. Therefore, clinicians should consult with a neurologist prior to performing the exercise test in these individuals, and deactivation of the DBS should be done by a trained clinician or neurologist. HR monitoring can be used when DBS is not activated. RPE should be used to monitor physical exertion levels during exercise testing.

In addition to the concerns, standard procedures, contraindications to exercise testing, recommended monitoring intervals, and standard termination criteria are used to exercise test individuals with PD. There have been no known serious adverse effects exacerbated by the interaction of PD medications and exercise. A few episodes of systolic blood pressure (SBP) drop of >20 mm Hg during treadmill training sessions have been reported. However, no association between medication usage and drop in SBP during exercise was found. Cognitive impairment is frequently observed in individuals with PD, although not all individuals with PD will experience cognitive deficits. This may present as feeling distracted, forgetful, slower thinking and information processing, and difficulty concentrating or managing complex tasks. It is recommended that all testing instructions be explained slowly, concisely, and repeated as necessary.

Exercise Programming

The main goal of the Ex-Rx for individuals with PD should ultimately be to slow down the rate at which the signs of the disease progress, reduce the signs of the disease, reduce comorbidities, prevent secondary complications from muscle disuse, and improve functional ability, independence, and quality of life. The FITT principle of Ex Rx should address CRF, muscular strength and endurance, flexibility, neuromotor training, and motor control. The ability to rigorously quantify, measure, and prescribe aerobic, resistance, and flexibility exercises has resulted in FITT principles of exercise design that focus predominantly on these three domains. However, the importance of incorporating neuromotor training and exercises that enhance motor control should not be overlooked or undervalued, regardless of the difficulty associated with determining a precise prescription for these types of exercises. Generally, neuromotor training should progress exercise motor complexity and quantitative training parameters (i.e., FITT principles). Exercise motor complexity refers to the coordinative and control requirements of the motor activity. Thus, exercise motor complexity and quantitative training parameters should not be prescribed simultaneously, as the former impairs the progression of the latter, but instead should be done sequentially.

Also, the importance of identifying exercise modalities that an individual enjoys should not be underestimated because adherence is a key ingredient to gaining maximal benefit from exercise. Because PD is a chronic and progressive disorder, an exercise program should be prescribed early when the individual is first diagnosed and continue a regular, lifetime basis. The Ex-Rx should be reviewed and revised as PD progresses because different physical problems occur at different stages of the disease.

The primary key health outcomes of an exercise program designed for individuals with PD are improved (a) aerobic capacity, (b) muscle strength and endurance, (c) gait mechanics, (d) balance, (e) physical function, and (f) flexibility. Because the FITT principle of Ex Rx recommendations for individuals with PD is based on a smaller literature, the Ex-Rx for healthy adults generally applies to those with PD; however, the limitations imposed by the disease process should be assessed, and the Ex-Rx should be individually tailored accordingly.

Table 4. FITT Recommendations for Individuals with Parkinson's Disease.

	Aerobic	**Resistance**	**Flexibility**	**Neuromotor**
Frequency	3–4 d · wk−1	2–3 d · wk−1	≥2–3 d · wk−1 with daily being most effective	2–3 d · wk−1
Intensity	High intensity (80%–85% maximum heart rate [HRmax]) for mild-to-moderate Parkinson's disease (PD); Moderate intensity (60%–65% HRmax) for deconditioned individuals or those with more advanced PD; progress to 80%–85% HRmax is possible	30%–60% of one repetition maximum (1-RM) for individuals beginning to improve strength; 60%–80% 1-RM for more advanced exercisers	Full extension, flexion, rotation, or stretch to the point of slight discomfort	N/A
Time	30 min of continuous or accumulated exercise	1–3 sets of 8–12 repetitions, beginning with 1 set and working up to 3 sets	Hold static stretch for 10–30 s; 2–4 repetitions of each exercise	30–60 min
Type	Prolonged, rhythmic activities using large muscle groups (e.g., walking, running, cycling, swimming, dancing)	For safety, avoid free weights for individuals in more advanced stages of the disease; focus on weight machines and other resistance devices (e.g., bands, body weight).	Slow static stretches for all major muscle groups	Exercises involving motor skills (e.g., balance, agility, coordination, gait, dual tasks) such as tai chi, yoga, multidirectional step training and instability training

It is important to note that the FITT principle of Ex Rx recommendations for resistance training in individuals with PD is based on literature with variable objectives with respect to study design and outcomes. Resistance training is well tolerated in individuals with mild-to-moderate PD and should be progressive. Physical parameters, such as muscle strength and power, movement speed, and dynamic balance, along with quality-of-life parameters such as fatigue, are improved with resistance training in individuals with PD, with strength improvements being similar compared to neurologically normal controls. Therefore, recommendations for resistance exercise in neurologically healthy older adults may be applied to individuals with PD. A recent modification to progressive resistance training that has proven beneficial for individuals with PD is the incorporation of unstable devices into the resistance exercises. Results from this type of training have shown improved mobility, motor

signs, neuromuscular outcomes, balance, reduced cognitive impairment, reduced fear of falling, and improved quality of life, which may be attributed to the progression of exercise motor complexity (i.e., degree of instability) and quantitative training parameters (i.e., frequency, intensity, and time).

Accumulating evidence suggests that long-term aerobic exercise may attenuate PD progression. General aerobic training at a moderate intensity may improve aerobic fitness, fatigue, mood, executive function, and quality of life in those with mild-to-moderate PD. High intensity endurance exercise (80%–85% HRmax) can be safely prescribed to individuals with early-stage PD (HY stages 1–2) and has been shown to attenuate the worsening of motor signs. Individuals should be encouraged to exercise at high intensity to the extent that they are willing to do this. Individuals at HY stages ≥3 should also consider high intensity aerobic exercise but check with their physician if they have autonomic dysfunction.

Recommendations for Neuromotor Exercise for Individuals with Parkinson's Disease

Endurance exercise, resistance exercise, and stretching will benefit posture and balance, but there are also benefits to performing exercises specifically for posture, balance, and mobility. Balance impairment and falls are major problems in individuals with PD, with approximately 61% of people with PD experiencing at least one fall and 39% of people suffering from recurring falls. Balance training is a crucial exercise in all individuals with PD. Postural instability and balance performance in individuals with mild-to-moderate PD can be improved with PA and exercise. Static, dynamic, and balance training during functional activities should be included. Clinicians should take steps to ensure the individual's safety (e.g., using a gait belt and nearby rails or parallel bars and removing clutter on the floor) when using PAs that challenge balance. Training programs may include a variety of challenging PAs (e.g., multidirectional step training, step up and down, reaching forward and sideways, obstacles, turning around, walking with suitable step length, standing up and sitting down). When external cueing in the form of rhythmic auditory stimulation is utilized during multidirectional step training, individuals with PD show improvements in functional gait parameters, including balance, and maintain these improvements longer than when external cueing

is not utilized. Tai chi, Tango, and Waltz are other activities to improve balance in PD. Incorporating unstable devices, such as balance pads, dyna discs, balance discs, BOSU balls, or Swiss balls, into a resistance training regimen has also been shown to improve balance in PD.

Exercise Training Modalities and Considerations

The selection of the exercise type is dependent on the individual's clinical presentation of PD severity and personal preference. In addition to treadmill exercise, stationary cycles, recumbent cycles, ellipticals, rowers, and arm ergometers are safe and effective modalities for aerobic training. Additionally, water exercises and robotic gait training are effective for some people living with PD. Virtual reality training, mental practice, boxing, and Nordic walking have a small amount of evidence supporting their use in PD. Dance programs, especially ones that include visual and auditory cues and rhythmic tasks, have been shown to improve some of the motor characteristics of the disease and improve functional mobility. Tai chi has been shown to be effective in improving motor function, balance, and quality of life in individuals with PD, with limited evidence also showing improvements in fall risk and depression. However, research behind the optimal dose and specific protocols for the varying PD subtypes and symptom burdens is limited.

Free weights may be utilized for individuals with mild-to-moderate PD. However, free weights may become unsafe at more advanced stages and in those with increased severity of tremor, especially during exercises that involve overhead lifting. Weight machines and other resistive devices such as resistance bands or body weight are safe alternatives to free weights. It may be necessary to modify certain exercises due to decreased ROM associated with PD. During resistance training, emphasize extensor muscles of the trunk and hip to prevent faulty posture. Train all major muscles of the lower extremities to maintain mobility.

Flexibility and ROM exercises should include slow static stretches and passive ROM exercises for all major muscle groups and joints, with an emphasis on the upper extremities and trunk. Spinal mobility and axial rotation exercises are recommended for all severity stages. Neck flexibility exercises should be emphasized because neck

rigidity is correlated with posture, gait, balance, and functional mobility. In addition, functional exercises such as the sit-to-stand, step-ups, turning over, and getting out of bed as tolerated should be incorporated in an exercise program to improve neuromotor control, balance, and maintenance of ADL.

The Lee Silverman Voice Training (LSVT) BIG program is an exercise-based behavioural treatment conducted by a certified therapist consisting of specific exercises involving large amplitude, exaggerated movement patterns. The exercises are performed with high intensity and effort that become progressively more difficult and complex, with the overall goal of restoring normal movement amplitude in real life situations and ADL. LSVT BIG has been effective at improving motor function in people with PD. Incorporating the concepts of this program into functional exercise may be beneficial.

Table 5. Nonmotor Symptoms in Parkinson's Disease.

Domains	**Symptoms**
Cardiovascular	Symptomatic orthostasis, fainting, light-headedness
Sleep/fatigue	Sleep disorders, excessive daytime sleepiness, insomnia, fatigue, lack of energy, restless legs
Mood/cognition	Apathy, depression, loss of motivation, loss of interest, anxiety syndromes and panic attacks, cognitive decline
Perceptual problems/hallucinations	Hallucinations, delusion, double vision
Attention/memory	Difficulty in concentration, forgetfulness, memory loss
Gastrointestinal	Drooling, swallowing, choking, constipation
Urinary	Incontinence, excessive urination at night, increased frequency of urination
Miscellaneous	Pain, loss of smell/taste and appetite/weight, excessive sweating, fluctuating response to medication

Special Considerations

- Some medications used to treat PD further impair autonomic nervous system functions. Levodopa/carbidopa may produce exercise bradycardia and transient peak dose tachycardia and dyskinesia. Caution should be used in testing and training an individual who has had a recent change in medications because the response may be unpredictable. Several nonmotor symptoms may burden exercise performance.

- The outcome of exercise training varies significantly among individuals with PD because of the complexity and progressive nature of the disease.

- Cognitive decline and dementia are common nonmotor symptoms in PD and may burden the training and progression. It is recommended that instructions be explained slowly, clearly, concisely, and repeated as necessary. Exercises should be demonstrated and broken down into a series of short, simple steps. Utilize verbal, visual, and tactile cues while instructing the individual.

- Fall history should be recorded. Individuals with PD with more than one fall in the previous year are likely to fall again within the next 3 month. Precautions should be taken to prevent falls whenever possible, such as avoiding narrow and/or uneven walkways, avoiding sharp turns and pivots, and removing any obstacles on the floor.

- Incorporate and emphasize fall prevention/reduction and education into the exercise program. Instruction on how to break falls should be given and practiced preventing serious injuries. Most falls in PD occur during multiple tasks or long and complex movement. If the exercise professional has any concerns, they should suggest that the individual should seek a referral for fall prevention training from a physical therapist.

- Balance training should be emphasized in all individuals with PD.

- Use dual tasking or multitasking with novice exercisers with great care. Individuals with PD have difficulty paying full attention to multiple tasks. Dual task performance during gait has been correlated with increased risk of falling and diminished quality of life. Dual task training has been shown to significantly increase stride length and cadence in individuals with PD and may also better prepare an individual with PD for responding to a balance perturbation. Dual task training can be incorporated into training once the individual is able to perform well in a single task.

- Visual and auditory cueing can be used to improve gait in persons with PD during exercise.

- Some individuals with PD experience freezing of gait (FOG), which is an intermittent feeling that their feet are “frozen” or stuck to the floor when trying to walk. While resistance and balance training do not seem to improve FOG in individuals with PD, utilizing both visual and auditory cues will help during, but will not necessarily alleviate freezing episodes. Utilizing exercise regimens that limit the opportunity for freezing episodes such as stationary cycling and resistance exercises alongside auditory cues are additional ways to handle FOG.

- Although no reports exist suggesting resistive exercise may exacerbate symptoms of PD, considerable attention must be paid to the development and management of fatigue.