Session 205: Mobility Made Easy in Patients with Parkinson’s Disease

Kara Doctor, MS, PT

#RehabSummit2017

Leading the Way in Continuing Education and Professional Development.
www.Vyne.com

Parkinson’s Disease- Overview

- Prevalence: Parkinson’s Disease (PD) is the second most common neurodegenerative disease behind Alzheimer’s disease. It currently affects over 1.6 million people in the United States, and it is estimated that the prevalence of the disease will grow substantially with the aging population, over the next two decades. 60,000 new patients are diagnosed each year.

- While the cause of PD remains unknown, there has been recent progress toward understanding the pathophysiology of the disease. There have been tremendous improvements in the development of treatment strategies and growth of pharmacological agents for PD.

- There has been recent advancement and refinement of surgical techniques, as well as recognition of nonmotor manifestations of PD.
**Epidemiology**

- Studies have reported that PD has an overall prevalence in the general population of between 84/100,000 to 775/100,000.
- There is a clear increase in prevalence with age.
- A Dutch study reported a prevalence of 1400/100,000 in those aged 55-64 years of age and 4300/100,000 in those aged 85-94 years of age.
- The mean age of onset is in the early 60s, but up to 10% of those with PD have an onset in the early 40s.
- The majority of studies report a male predominance, with a roughly 3:2 ratio of males to females.

**Economic Impact**

- The economic burden for the cost of the illness can be measured in direct and indirect costs.
- Direct costs = medications and healthcare costs
- Indirect costs = lost productivity, cost of providing care and mortality costs.
- In the United States, the combined direct and indirect cost of Parkinson's is estimated to be nearly $25 billion per year.
- Almost 50% of the total economic cost of PD is loss of productivity, while just shy of 20% was for both inpatient care and uncompensated care. Prescription drug costs accounted for less than 5% of the total cost.
The cortical areas involved in movement control need “assistance” from other brain circuits in order to smoothly orchestrate motor behaviors. One of these circuits is the basal ganglia. Without the basal ganglia, the cortex is unable to direct motor control properly and the deficits seen in Parkinson’s Disease and related movement disorders become apparent.

A very simple explanation of neuroanatomy can be found at: http://www.neuroanatomy.wisc.edu/coursebook/motor2.pdf

The anatomy of the basal ganglia consists of two important structures, the caudate and putamen.

The caudate and the putamen together are called the neostriatum.

All input that comes to the basal ganglia comes via the neostriatum.

The input mainly comes from the motor cortical areas.

Medial to the putamen is the globus pallidus (GP).

Anatomically the putamen and the globus pallidus are shaped like a lens and therefore are referred to as the lenticular nucleus.

PD is slow and steady loss of dopaminergic neurons in the substantia nigra pars compacta (SNc).

In PD, the activity in direct pathways to the interior globus pallidus decreases while activity in indirect pathways to the external globus pallidus increases. This causes excessive inhibition of the thalamus. The increase in inhibition of the thalamic neurons, in effect, “turns down” motor activity from the cortex. This is why PD patients have tremors and trouble performing voluntary movements.
Anatomy and Function

- The basal ganglia are associated with motor control, emotions, cognition, and learning.
- The caudate works with the putamen to receive the input from the cerebral cortex. They are considered the “entrance” to the basal ganglia.
- In order to control movement, the putamen must interact with the other structures that make up the basal ganglia.
- One of the main transmitters that is regulated by the putamen is dopamine.

Types of Parkinson’s Disease—Cardinal Manifestations

- The four cardinal features of PD are:
  1. Tremor
  2. Bradykinesia
  3. Rigidity
  4. Postural Instability

- The three types of PD are:
  1. Tremor Dominant
  2. Rigid-Akinetic
  3. Mixed—Rigid akinetic/Tremor dominant

Exercise Benefits

- The number of publications addressing exercise for PD has more than tripled in the past decade.
- Exercise has the potential to help both motor (balance, gait, strength/endurance) and nonmotor (depression, apathy, fatigue, constipation) aspects of PD, as well as secondary complications of immobility (cardiovascular, osteoporosis).
The Effect of Exercise Training in Improving Motor Performance

• In a recent study conducted by Beth Fisher et al., researchers at the University of Southern California found that exercise may have an effect on the brain. On a day-to-day basis, people with PD, who exercised, moved around more normally than those who did not. Based on these findings, they believe that exercise may be helping the brain to maintain old connections, form new ones and restore lost ones. They suggest that, in certain situations, the neuroplasticity created from exercise in patients with PD may actually outweigh the effects of neurodegeneration.

Many studies have suggested that physical exercise can have an antidepressant effect by increasing the levels of brain-derived neurotrophic factors (BDNF). Studies have shown that regular exercise improves sleep quality in normal aging, as well as many aspects of sleep in PD.

Neuroplasticity
Neuroplasticity

The term *Neuroplasticity* is derived from the root words Neuron and Plastic. A neuron refers to the nerve cells in our brain. Each individual neural cell is made up of an axon, dendrites, and is linked to one another by a small space called the synapses. The word plastic means to mold, sculpt, or modify. Neuroplasticity refers to the potential that the brain has to reorganize by creating new neural pathways to adapt, as it needs.

New neural cells are generated throughout a lifetime, as well as the generation of new neural pathways.

The elderly can create measurable changes in the brain organization. These changes are not always easy but can happen through concerted effort.

According to the Journal of Neurology, “Parkinsonian animal models reveal exercise-related protection from dopaminergic neurotoxins, apparently mediated by brain neurotrophic factors and neuroplasticity.”

There is increasing evidence suggesting that ongoing vigorous exercise may favorably influence the progression of PD.

“Exercise consistently improves cognition in animals, also linked to enhanced neuroplasticity and increased neurotrophic factor expression. In these animal models, immobilization has the opposite effect.”

“In humans, exercise increases serum brain-derived neurotrophic factors (BDNF), which is known to cross the blood-brain barrier.”

PD risk in humans is significantly reduced by midlife exercise, documented by enlarged prospective studies.
Exercise Benefits

- Exercise, or physical fitness has not only been associated with better cognitive scores, but midlife exercise significantly reduces the later risk of both dementia and mild cognitive impairment.
- Numerous studies in seniors, with and without dementia, have reported increased gray matter volumes associated with physical fitness or exercise.

Suggestions For Exercise Guidelines in PD

- As the scientific evidence supporting the benefits of exercise for PD is growing, all PD patients should be STRONGLY encouraged to increase physical activity and exercise regularly.
- Although PD patients suffer from physiological restrictions that require specific attention around exercise, recommendations specific to PD patients do not exist.
- Guidelines from the American College of Sports Medicine (ACSM) for older adults >50 years with a chronic disability, could serve as a good starting point.
- ACSM guidelines recommend incorporating aerobic, strengthening, flexibility, and balance training. Specifically, aerobic training should be done at least 5 x /week, for 30 minutes at moderate intensity or at least 3 x per week for 20 minutes at vigorous intensity.
- All PD patients should be encouraged to exercise at their optimal medicated state.
Exercise Guidelines in PD

The ACSM recommends at least 2 days of strength training (8-10 exercises involving major muscle groups) and at least 2 sets of 10-15 repetitions. And flexibility exercises for at least 10 minutes.

It has been recommended that for PD patients, a strong focus on strengthening the extensor muscle groups, in order to counteract the flexion of hips and trunk musculature. Focus on flexibility training to flexor, axial and cervical muscles.

Balance training should be initiated early to prevent postural instability and reduce the risk of falls.

Vigorous Exercise

- This may mean something different to each of us, but for these purposes, we are referring to aerobic physical activity that is enough to increase the heart rate and the need for oxygen.
- For this to be meaningful, it should be sustained (30-40 minutes) and repeated (3-4 times per week) and ongoing (lifetime).
- Physical/Occupational/Speech therapy is routinely utilized in PD treatments, the focus is largely based on ADL’s, gait and balance training, stretching and voice volume.
- Our treatment needs to be more directed to physical fitness.
- This may be an area that is a neglected opportunity for disease modification in the PD community.

Exercise and PD

- Use imagery, focus, meditation.
- Techniques such as Tai Chi and Yoga are helpful.
- LSVT Big and Loud activities focus on over-exaggerating movement and voice to recreate old pathways.
Parkinson’s and Exercise

- Exercises that challenge them to change tempo, direction or activity frequently.
- Activities that involve paying attention and learning, such as dancing, are good forms of exercise to include.
- People with PD should aim to exercise four or five times per week for at least 30-40 minutes.
- The heart rate should be maintained between 70-80% of its maximum, which is 220 minus the person’s age.
- Lifting light weights and performing closed chain exercises can be particularly beneficial.

Tai Chi

- Tai Chi naturally combines slow control of movement, strength, multidirectional movement, and complex sequential action requiring cognitive attention. It has been known to improve balance in the elderly, and has a strong emphasis on maintaining control of one’s center of mass.

Tai Chi

Excellent exercise for balance, flexibility, body awareness and breathing.
- Hug the tree.
- Feel the cliff.
Dancing

- Dance has receiving attention as an interesting exercise strategy for PD because it naturally combines cueing, spatial awareness, balance, strength and flexibility, and physical activity (or even aerobic activity if the intensity is sufficient). It is enjoyable and stimulates social engagement and peer support.
- Recent studies show improvement in nonrelated tasks after a 12 month program, dancing 2 x per week for 60 minutes, suggesting a disease modifying effect.

Agility Training

- Agility Training involves a sensorimotor agility program, in which the predictable restraints on mobility are targeted (rigidity, bradykinesia, sensory organization and freezing of gait).
- A research article by King, et al. proposed that using sensorimotor progressions (visual or surface changes, dual tasks) alongside traditional exercises resulted in improved outcome measures after 4 weeks, when compared to treadmill training alone.
Yoga and Modified Yoga

- Core strengthening is vital for any exercise plan.
- Deep breathing, diaphragmatic breathing and pursed lip breathing. The diaphragm can be affected in PD and exercises to promote deep breathing help to strengthen the diaphragm and improve breath support and speech.
- Stretching is an essential part of exercise, for PD patients it helps relieve tight muscles affected by dystonia.
- Calf and hamstring stretching- Downward dog
- Prone on elbow and upward dog are great for posture.

Yoga and Stretching

- Exercise is an important part of healthy living for everyone. For people with PD, exercise is more than healthy, it is a vital component to maintaining balance, mobility and the ability to perform activities of daily living.
- The Parkinson’s Outcomes Project shows that people with PD who exercise a minimum of 2.5 hours per week, experience a slowed decline in quality of life measurements. After 6 months of exercise, scores improved by approximately 30%.
- Establishing early exercise habits is an essential part of overall disease management.
Exercise Equipment

- Body Blade
- Ziddy Sticks
- Shaker Weights
- Vibration platform
- Floor pedals
- Balloons
- Therapy Ball

Heart Rate and Perceived Exertion Scale

- The patient’s heart rate should be calculated as follows: 220-age = max HR. A patient should exercise at 70-80% of their max. For example, if my patient is 70 years old, their max HR is 220-70 = 150. Exercise zone is 150 x .70 = 105. 150 x .80 = 120. So, this patient’s ideal exercise zone is 105 beats per minute to 120 beats per minute.
- Perceived exertion scale can be used to help identify intensity of exercise. Ideally, the patient should exercise between 6 and 8 on the perceived exertion scale.
Endurance

- Treadmill - Freezing gait, forced use exercise, Swiss ball intervals
- Walking
- Elliptical
- Bicycle-recumbent, upright, stationary, tandem, trainer, spin, Thera-Cycle
- Swimming - water aerobics, walking, kickboard
- Boxing - Rock Steady Boxing
- Dancing
- Mowing, cleaning, yardwork, ADL’s
- Upper Extremity Exercises - UBE, balloon, Swiss ball

Strength Training

- Weightlifting - Free weights vs. Machines
- Theraband
- Closed chain exercises - upper body, lower body, core
- Weightbearing exercises
- Water weights
- Pottery, Ceramics, Quilting, Sewing, etc.
Strength Training (cont.)

- Use your professional judgement.
- Closed chain exercises are typically safer to begin with.
- Educate on proper form, proper posture and proper technique.
- Functional activities that compress the joints help improve joint health and increase bone density. Squats, lunges, push-ups, wall slides, therapeutic ball exercises.

Balance

- Seated
- Standing
- Upper extremity support
- Weight shift: SKLZ Recoil 360 ($39.00-60.00)
- Foam and dome (somatosensory, vestibular, visual)
- WiiFit
- Balance board
- Water exercise
- Therapeutic ball

Diaphragmatic Breathing
**Diaphragm Exercises**

There are also a number of simple exercises, requiring no equipment, to assist and strengthen the diaphragm. Here is one for you to try:

1. Lie on the floor face up with knees slightly bent.
2. Place a small pillow under the head if that is more comfortable for you.
3. Place your hands lightly on your stomach.
4. Concentrate on breathing using the diaphragm, not using the chest, and feeling the stomach rise as the lungs fill from the bottom.
5. Let the stomach fall naturally when breathing out by relaxing the diaphragm.
6. Progress by placing a small weight on the stomach, such as a small book, and do it all again.
7. The next stage is to stand up and place your hands on your stomach again, feeling how you breathe. Surprisingly, you may find this step requires some concentration initially.

**More Traditional Exercises**

**Vigorous Exercise**

**Vigorous intensity aerobic exercise** is where you’re breathing hard and fast and your heart rate/energy expenditure has increased significantly.
Where To Start

- Start with your initial evaluation.
- Get a feel for what their endurance is like.
- 6 Minute Walk Test.
- Set realistic and achievable goals for them to progress—add 2 minutes per week until they reach 30 minutes, then increase the intensity.
- Interval Training is effective for elevating heart rate and increasing intensity of exercise.
- Timed Get Up and Go
- 30 Second Sit to Stand Test

Dr. Henry

74 year old male with history of PD x 12 years. Retired anesthesiologist. S/P bilateral STN DBS Unable to walk for 5 minutes on the treadmill 6 months ago. Performs vigorous exercise x 45 minutes, 3-4 times per week.

Floor Exercises

- Stand to floor transfers
- Developmental Positions-Reversed
- Abdominal Exercises
- Diaphragm Exercises
- Closed Chain Exercises
- Push Ups/Press Ups
Turkish Get Up - Developmental positions

Closed Chain Exercises

- Downward Facing Dog
- Upward Facing Dog (Prone Press Ups)

Start Low and Move Slow

- Squats
- Wall Push Ups
- Floor exercises
- Closed Chain Exercises
Home Exercise Program
Dr. Henry
Modify as needed. Repeat as tolerated

Warm up: (15-20 reps each)

- Sit to stand with overhead reach and toe raise.
- Biceps curls with bar.
- Squat with bar over shoulders.
- Trunk twists with bar over shoulders.
- Dead lift with bar (head up, butt out, hang).
- Pushups

Treadmill:
Start at your regular speed for 3 minutes. Then increase your pace or the incline and go as fast as you can for 30 seconds. Go as hard as you can without becoming short of breath. Then resume your regular speed for 2 minutes. Repeat as tolerated throughout your walk. Try walking for 15-20 minutes with heart rate elevated.

If you experience chest pain, become lightheaded or nauseated, STOP immediately and contact your doctor OR call 911.

Progressive Resistance Exercise:
Perform each exercise slow and with good form. Try to perform 8-12 repetitions. When it becomes easy or you can perform 15-20 reps, increase the weight. Try Circuit Training, 4-6 machines, alternating body parts for 2-3 sets. Don't rest between machines. If something hurts, modify your movement or stop. If you are unable to recite your name without shortness of breath, SLOW DOWN.

Exercises:
- Pull single weight up to chin.
- Single weight in hand, lean to side and straighten.
- Chest Press on bench.
- Single arm rows.
Sample Home Exercise Program
Modify as needed. Repeat as tolerated

Walking With Your U-Step:
Walk with your U-Step walker for 3 minutes everyday without rest. After 1 week, increase to 5 minutes. Try increasing your walking time by 2 minutes each week. When this becomes EASY, or you reach 20 minutes, you may try INTERVALS. Start at your regular speed for 2-3 minutes. Then increase your speed for 30 seconds. Go as hard and fast as you can without becoming short of breath. Then resume your regular speed for 2 minutes. Repeat as tolerated 2-6 times, or as tolerated throughout your walk.

If you experience chest pain, become light-headed or nauseated, STOP immediately and contact your doctor OR call 911.

PERCEIVED EXERTION SCALE:
0 = No exertion
10 = Exhaustion
Exercise in between 5 and 7, where you are tired but not breathless and you can recite your name and address.

If something hurts, modify your movement or stop.
If you are unable to recite your name without shortness of breath, SLOW DOWN.

Follow up with Kara in 3-4 weeks to update and modify your exercise program.

Sample Home Exercise Program
Modify as needed. Repeat as tolerated

Walking With Your U-Step:
Walk with your U-Step walker for 3 minutes everyday without rest. After 1 week, increase to 5 minutes. Try increasing your walking time by 2 minutes each week. When this becomes EASY, or you reach 20 minutes, you may try INTERVALS. Start at your regular speed for 2-3 minutes. Then increase your speed for 30 seconds. Go as hard and fast as you can without becoming short of breath. Then resume your regular speed for 2 minutes. Repeat as tolerated 2-6 times, or as tolerated throughout your walk.

If you experience chest pain, become light-headed or nauseated, STOP immediately and contact your doctor OR call 911.

PERCEIVED EXERTION SCALE:
0 = No exertion
10 = Exhaustion
Exercise in between 5 and 7, where you are tired but not breathless and you can recite your name and address.

If something hurts, modify your movement or stop.
If you are unable to recite your name without shortness of breath, SLOW DOWN.

Follow up with Kara in 3-4 weeks to update and modify your exercise program.

Stretches

- Long stretch on back.
- Hamstring stretch.
- Figure 4 stretch.
- Press ups.
- Child’s pose.

PERCEIVED EXERTION SCALE:
0 = No exertion
10 = Exhaustion
Exercise in between 5 and 7, where you are tired but not breathless and you can recite your name and address.

If something hurts, modify your movement or stop.
If you are unable to recite your name without shortness of breath, SLOW DOWN.

Follow up with Kara in 3-4 weeks to update and modify your exercise program.
Heart Rate and Monitors

- The Goal is to exercise with your heart rate elevated for 30-40 minutes, 3-4 times per week!
- Your Max Heart Rate (HR) beats/minute (bpm)
- Your Exercise Zone is: bpm
- Consider Heart Rate Monitor: Try Polar FT4M, Timex, Fitbit Charge HR

Lower Level Patients (SNF, ALF, NF)

- Walking with an assistive device.
- Upper Extremity Bike.
- Balloon Exercises.
- Closed Chain Exercises.
- Start Low and move SLOW.
- Wheelchair push ups.
- Wall push ups.
- **Lower level Exercises: Review 4 Go-To Exercises.**

Pick an Exercise You Can Stick With

- Individual Activity- Self Motivated
- Group Activity- Socialization
Rigorous activity: Increasing Your Energy Expenditure and pushing yourself.

Review of Evidence

Exercise Research - The Latest on Research into Parkinson’s and Exercise

At Rhodes University in Memphis, Dr. Gerecke et al. report that exercise can protect mice against toxic exposure. MPTP is a neurotoxin that is used as an animal model for PD, as it selectively kills dopamine neurons in the substantia nigra. Dr. Gerecke showed that 3 months of exercise provided complete protection against MPTP-induced neurotoxicity in mice. Also, if the duration of running was limited to 1 or 2 months or if the amount of daily running was decreased, the protective effects of the exercise were abolished. Thus, daily, sustained exercise was necessary for full protection.
Dr. Gerecke also found that 3 months of exercise induces changes in proteins related to energy regulation, cellular metabolism, cytoskeleton dynamics, and intracellular signaling events. This means that exercise must be sustained (30-40 minutes), repeated (4-5 times per week), and ongoing (lifetime) to be meaningful in PD.

Dr. Zigmond, at the University of Pittsburgh

- Dr. Zigmond et al. found that exercise reduces the impairments elicited by dopaminergic neurotoxins as well as loss of DA neurons. This study focused on one of several possible explanations for the beneficial effects of exercise: an exercise-induced increase in the expression of BDNF, specifically GDNF (glial-derived neurotrophic factor). Observations indicate that GDNF can reduce the vulnerability of DA neurons, in part due to the activation of key intracellular cascades.
- This raises the possibility that some individuals with PD suffer from a reduction of these neuroprotective mechanisms, and the treatments that boost these mechanisms— including exercise— may provide therapeutic benefit.

Cleveland Clinic - Dr. Alberts et al.

- Dr. Alberts et al. found that when people with PD pedaled on a stationary bike 30% faster than their preferred “voluntary” rate (or forced exertion), they not only gained in aerobic fitness, but also showed improvement in motor function and coordination, as well as manual dexterity. This improvement was retained some weeks after the exercise stopped.
Review of 14 Treadmill Studies

- A review on treadmill training found that 3 studies show an immediate effect of increased walking speed, longer stride length and improved balance as early as after one treadmill session.
- Longer term trials, numbering 11 in total, demonstrated not only safety, but positive benefits in gait speed, stride length and related quality of life even several weeks later.
- These reviews are just a few in the mounting evidence that shows that for people with PD, exercise is an ESSENTIAL PART of disease management.
- Many researchers are working to better understand this, what makes it happen, and how to achieve the best results.

In-Step Mobility Products, Inc.

U-Step Walking Stabilizer
1-800-558-7837
Stop Falls and Increase Mobility

Resources

- National Parkinson's Foundation  www.parkinson.org  1(800)473-4636
- Michael J Fox Foundation  www.michaeljfox.org
- American Parkinson's Disease Association (APDA)  www.apdaparkinson.org
- Davis Phinney Foundation  www.davisphinneyfoundation.org  Victory Summit, Parkinson's Exercise Video
- Local Support Groups
- APDA  City Chapter
- Parkinson's Disease Foundation (PDF)  Hope Through Research
- Parkinson Action Network (PAN)  www.parkinsonaction.org
- Register with Fox Trial Finder to be matched with clinical studies in your area.
- Rock Steady Boxing  info@rocksteadyboxing.org
Bibliography


- Shulman, LH, et al. (2011). "Randomized Clinical Trial of 3 Types of Exercise for Patients With Parkinson’s Disease." JAMA Neurol, 70 (1): 1-172220, Fax +1 218 626 1638, Email marty@hinzmd.com

Received February 26, 2011

Bibliography (cont.)


• Da Silva, PG. et.al. (2016) "Neurotrophic Factors in Parkinson’s Disease are Regulated by Exercise in a Brain-Region Specific Manner". Journal of Neurological Science. 2016; Apr 94 (4): 5-15.
• Tuom, T. et.al. (2016) "Physical Training Prevents Depressive Symptoms and a Decrease in Brain-Derived Neurotrophic Factor Expression in Parkinson’s Disease". Brain Research. 2016; Sep 10: 115-121.
Thank you for your participation.

Kara M. Doctor, M.S., PT