Objectives

1. Identify and distinguish the different types of Parkinsonisms and symptoms related to Parkinson’s disease and how it may affect treatment.
2. Identify the correct stage of Parkinson’s Disease and the potential effectiveness of physical therapy treatment in each stage.
3. Complete a comprehensive physical therapy evaluation using outcome measures recommended from the Academy of Neurologic Physical Therapy Parkinson EDGE Task Force.
4. Understand the theoretical basis for what type of exercise and why it may benefit people with Parkinson’s disease.
5. Develop an exercise program for people with Parkinson’s disease and provide evidence-based treatment approaches; not limited to dual-task training, task-specific high-intensity training, and improving amplitude of movement.

Parkinson’s Disease

- 2nd most common progressive neurodegenerative brain disorder
- Estimated number of patients with PD to reach 8.7 million by 2030
- Total cost in US is $52 billion/year
- Combination of underlying genetic predisposition and environmental exposures

Characteristic features

- Tremor at rest
- Rigidity
- Akinesia / Bradykinesia
- Postural Instability & Gait Dysfunction

Parkinson’s Disease: Translating Research into Clinical Practice

AMY WEDGE, PT, DPT, CBIS
BOARD CERTIFIED NEUROLOGIC CLINICAL SPECIALIST

Parkinson’s Disease

- Loss of dopamine caused by degeneration of substantia nigra pars compacta dopaminergic neurons
- Depletion of 60-80% of dopaminergic neurons prior to seeing motor symptoms
- Occurring PD motor symptoms as early as 20 years prior to diagnosis
- Loss of smell
- Rapid eye movement sleep behavior
- Constipation
- Depression/Anxiety
- Impaired autonomic function

Savica 2010

Parkinson’s

- Tremor
- Rigidity
- Akinesia / Bradykinesia
- Postural Instability & Gait Dysfunction

Savica 2010

- Sleep difficulties
- Bladder Dysfunction
- Pain
- Depression
- Gastric Reflux
- Hemorrhages
- Dementia
- Sweating
- Erectile difficulties
Team Parkinson’s

- Movement Disorder Specialist
- Physical Therapist
- Occupational Therapist
- Speech Therapist
- Recreational Therapist
- Social Worker
- Neurosurgeon
- Primary Care Provider
- National & Local Parkinson’s Society
- Neuro Psychologist
- Pharmacist
- Neurologist

Non-motor symptoms

- Autonomic Dysfunction
  - Hypotension
- Cognitive impairments
  - Frontal lobe executive function
- Sleep Disturbances
  - Circadian sleep-wake dysfunction
  - Insomnia
  - Excessive Daytime Sleepiness with sleep attacks
  - REM Behavior Disorder (RBD)
  - Restless Leg Syndrome (RLS)
  - Obstructive Sleep Apnea

Scales to Stage Parkinson’s Disease

- Unified Parkinson’s Disease Rating Scale (UPDRS)
  - Updated in 2007 (MDS-UPDRS)
  - Modified H&Y

<table>
<thead>
<tr>
<th>Stage</th>
<th>H&amp;Y</th>
<th>Modified H&amp;Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Unilateral involvement with min or no functional disability</td>
<td>Unilateral involvement only</td>
</tr>
<tr>
<td>1.5</td>
<td>-</td>
<td>Unilateral &amp; axial involvement</td>
</tr>
<tr>
<td>2</td>
<td>Bilateral or midline involvement without balance impairments</td>
<td>Bilateral involvement without balance impairment</td>
</tr>
<tr>
<td>2.5</td>
<td>-</td>
<td>Mild bilateral disease with recovery on pull test</td>
</tr>
<tr>
<td>3</td>
<td>Bilateral disease: mild-mod disability with impaired postural reflexes; physically independent</td>
<td>Mild to mod bilateral disease; some postural instability; physically independent</td>
</tr>
<tr>
<td>4</td>
<td>Severely disabling disease; still able to walk or stand unassisted</td>
<td>Severe disability; still able to walk or stand unassisted</td>
</tr>
<tr>
<td>5</td>
<td>W/c bound or bedridden unless aided</td>
<td>W/c bound or bedridden unless aided</td>
</tr>
</tbody>
</table>
Subtypes of Parkinson’s

- Young Onset PD
- Tremor Dominant
- Postural Imbalance & Gait Disorder (PIGD)
- Rapid Disease Progression without Dementia

YOPD

- <55 y.o.
- Genetics plays a larger role
- Financial, family, & employment challenges
- More side effects from dopaminergic medications
- Dystonia
- Late onset of falls (approximately 15 years)
- Early onset of freezing (50% after 10 years versus 15 years)
- Slower Disease Progression

Tremor Dominant

- Poorer response to levodopa, but slower disease progression
- Lower risk for depression and mood impairments
- Longer time to and lower risk of dementia compared to PIGD-type

Postural Balance & Gait Disorder

- Predominant gait and posture impairments
- Higher prevalence and severity of depressive symptoms
- Higher prevalence of dementia

Rapid Disease Progression without Dementia

- Older age at onset
- Early depression
- Early midline motor symptoms

Parkinson-Plus Syndromes (Parkinsonisms)

- Progressive Supranuclear Palsy (PSP)
- Multiple System Atrophy (MSA)
- Corticobasal Degeneration (CBD)
- Dementia with Lewy Bodies (DLB)
- Vascular Parkinsonism (VP)
Progressive Supranuclear Palsy

Most common form of atypical Parkinson's.
Age of Onset: 60's
Tremors are RARE
Specific diagnostic feature: supranuclear gaze palsy
Gait Instability & Falls are early manifestations
Other symptoms: rigidity of neck/trunk, bradykinesia, impaired balance, speech/swallowing difficulties, cognitive decline

Multiple System Atrophy

- 2nd most common form of parkinsonism
- Autonomic d/o
- Unstable BP – usually orthostatic hypotension
- Early disturbance of sexual, bladder, and bowel dysfunction
- Abnormal perspiration
- Cold hand sign
- Marked Sleep disturbances
- Rapid progressive course with inability to amb usually in 3-5 yrs of onset

Clinical Presentation

- Asymmetrical presentation
- Apraxia
- Alien Limb
- Limb dyskinesia or Myoclonus
- Progressive aphasia & Myoclonus
- Dementia occurs in more advanced stages
- Loss of inhibition
- Loss of sensation on 1 or both sides of body

Corticobasal Degeneration

AKA Corticobasal Syndrome & Corticobasal Ganglionic Degeneration
Gradual neurodegeneration in cerebral cortical areas as well as BG
Sx worsen over 3-8 yrs with gait and speech impairments
Gait & balance impairments occur later in disease progression compared with other forms of atypical parkinsonism

Lewy Body Dementia (LBD)

- Affects approx. 1.4 million people in US
- Visual Hallucinations
- Parkinsonism features with early dementia
- Myoclonus
- Impaired executive function
- Agitation

Vascular Parkinsonism

- Caused by small CVA's to the BG
- Not a progressive neurodegenerative disease like PD
- Symptoms occur suddenly
- Impaired gait/balance
- Greater sx in LE's
- Does not respond well to typical PD meds
Medical Diagnostics & Interventions

- **DaTscan**
- **Surgery**
- **Dopaminergic Therapy**

**DaTscan**
- Developed to distinguish between PD and essential tremor
- Abnormal in any disease in which there is a loss of dopamine
- MRI imaging will appear normal in PD

**Deep Brain Stimulation (DBS)**
- Does not cure PD
- Improves tremors, rigidity, bradykinesia, and dyskinesia
- Never improves symptoms that don’t respond to best “on” period
- Will only decrease medication use in some
- Those with Parkinsonism syndromes will not benefit and surgery can make symptoms worse
- Increase risk for falls after DBS placement

**Dopaminergic Therapy**
- Should start as soon as diagnosed
- Carbidopa/Levodopa is gold standard
- Deferring treatment may have long-term consequences
- Treatment Goal: optimal dose that allows the patient to be active and fully life-engaged, including exercise

**Adverse Effects**

**Nausea**
- Medication options for nausea include supplementary carbidopa (Lodosyn)

**Orthostatic hypotension**
- PL’s may already be on meds prior to PD diagnosis: antihypertensives, α blockers, and/or diuretics.
- Orthostatic BP should be assessed and systolic pressure should not be <90 mm Hg

**Dyskinesias**
- Just as too little brain dopamine translates into motor slowness, too much dopamine results in excessive movements.
- Amantadine works well to attenuate dyskinesias

**Adverse Effects of Dopamine Agonists**

- Sedation / sleep attacks
- LE edema
- Pathological behaviors
- Hallucinations
- 3-fold risk for hallucinations
- Impulse control disorders
“Off times”
- Motor fluctuations
- Time period when meds wear off
- May benefit from increasing dose frequency of meds
- Important to assess and treat patients during off times

Medications alone are not therapeutic
- Dopamine replacement therapy alleviates some motor symptoms, but has poor effect on cognitive function and does not improve motor learning

What Physical Therapists Can Do

- PT Evaluation
  - History (when diagnosed, current meds, DBS, falls?)
  - Vitals
  - Pain
  - ROM
  - MMT
  - Vision
  - Posture
  - Functional Mobility: bed mob, transfers, gait, stair negotiation

PDEDGE Recommendations

- Body Structure & Function
- MDS-UPDRS revision – part III
- MDS-UPDRS – part I
- MoCA
- Activity
- 6MWT
- 10m walk test
- Mini BESTest
- MDS-UPDRS – part II
- FGA
- SST
- 9 Hole Peg Test
- Participation
- PDQ-8 or PDQ-39

- Personal Factors
  - Education level
  - Spousal status
  - Depression
  - Physical limitations
  - High blood sugar

- Environmental Factors
  - Family support
  - Rehabilitation
  - Independence
  - Loneliness
  - Difficulty in drive
  - Unemployment

- RECOMMENDED SPECIFIC CONSTRUCTS
  - Freezing of gait
  - FREGAT
  - Fear of falling
  - Fatigue
  - Inability to walk
  - Dual Task

- Other (non-PDEDGE) measures
  - 3 min backward walk test
  - 200 yard test (right and left)
  - PDQ-39
Outcome measures

- Mini-BESTest score < 20/32 at baseline had a significantly higher risk of sustaining recurrent falls in the next 6 months. A score >24/32 demonstrated fall risk.
- 10MWT Normal walking speed: >1.2 m/s. Minimal detectable change: 0.18 m/s for preferred speed and 0.25 m/s for fast speed.
- gait speed: Minimal detectable change: 82 meters (269 feet).
- 5xSST: > 16 seconds indicates fall risk in PD.
- Functional Gait Assessment (FGA): Scores <19/30 indicates fall risk in PD.
- ABC Scale: Norm is 73.6%. Scores <70% is predictive of recurrent falls in PD.
- >4.5 sec for 3 m backward test (in health adults), very likely to have reported a fall.

Gait Impairments in PD

- Decrease speed
- Decrease step length
- Increase stride-tostride variability
- Decrease heel strike
- Decrease arm swing or absent arm swing
- Decrease velocity
- Difficulty turning
- FOG
- Festination
- Narrow BOS
- COG is ant to BOS – forward flexed posture
- Increase double-limb support time
- Shuffling Gait
- Decrease trunk/pelvic rotation

Freezing of Gait Assessment

- Can occur at any stage of disease
- Start hesitation (Weak “GO” signal)
- Stop hesitation (Weak “NO GO” signal)
- Occurs in approx. 26% in mild PD, 80% in severe PD
- Can occur with gait, ADL’s, and speech
- Common cause of falls
- DBS & Dopaminergic meds don’t help
- Sensorimotor, executive functioning, attention, and visual spatial deficits
- FOG severity & frequency is associated with decreased activity levels & disease severity

FOG Triggers

- Stress/anxiety
- Turning
- Anticipation of Freezing
- Large Crowds
- Changes in Terrain / Flooring / Patterns
- Doorways / Thresholds / Elevators
- Too much clutter / furniture in a room
- Distractors
- Backward Steps

FOG Treatment

- Progress from closed to open environments
- Include identified freezing triggers
- Diminish verbal & non-verbal cues over time
- Gradually add distractors, real environment, and dual tasking
- GOAL: REDUCE FREQUENCY OF FREEZING
FOG Treatment Considerations

- Never fight a freeze
- Focus on amplitude of movement
- Add motor and cog dual tasks as able
- External environmental cues
- Internal cues (4 S's)
  1. Stop
  2. Stand Tall
  3. Shift Weight
  4. Step Big

Balance Impairments in PD

- Abnormal postural sway in stance
- Decrease limit of stability
- Abnormal anticipatory postural adjustments
- Poor reactive postural responses
- Retropulsion
- Slowed/absent righting reflexes

Balance Impairments in PD

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- Decrease limit of stability
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Falls

- Fall history is the MOST significant predictor of future falls in PD
- 52% PWP have 1st fall within 3 years of dx
- 22% of individuals report falls when dx
- Those with PD are 3x more likely to sustain a hip fx
- Decrease gait speed & SLS time are significant predictors of 1st fall
- Fall prone functional activities:
  - Reaching
  - Stepping
  - Turning
  - Single/dual task walking

Cognitive Impairments & PT

**Attention**
- Divided: Dual Tasking
- Switching: Changing focus quickly

**Executive Function**
- Shifting: Problem solving
- Inhibition: Go-no-go
- Visuospatial: Associated with freezing

Automaticity

- Performing a skilled movement without conscious attention
- Depletion of dopamine impairs automatic circuitry & cognition (executive functions)
- Presents as decreased dual task ability
- Can be improved with goal-based aerobic exercise

Neuroplasticity in PD

- Both BDNF and GDNF are significantly reduced in SN in PWP
- Goal-based & aerobic training may enhance neuroplasticity
- Exercise may drive re-acquisition of the lost automatic (habitual) movements in people with PD
- Animal studies show neuroprotective & neurorestorative capacity of intensive exercise
Exercise and Neuroplasticity in PD

5 key principles that enhance neuroplasticity in PD

- Intensive activity maximizes synaptic plasticity
- Complex activities promote greater structural adaptation
- Activities that are rewarding increase dopamine levels & promote motor learning
- Dopaminergic neurons are highly responsive to exercise and inactivity
- When exercise is introduced early, progression can be slowed

Benefits of Exercise in PD

- Improves QOL
- Improved cognition
- Arrest osteoporosis
- Prevent cardiovascular events
- Prevent Depression
- Improves Sleep
- Helps with constipation
- Decreases fatigue
- Improved motor performance
- Improved drug efficacy
- Optimized Dopaminergic signaling
- Improves Pain

PD Treatment

- Early Stage (1&2)
  - Address Amplitude & Symmetry
  - Add dual tasking with both cognitive and motor loads
  - High intensity
- Mid Stage (3)
  - Address festination, retropulsion, LOB
  - Motor fluctuations with on/off times

AMPLITUDE matters at all stages & ages of PD

Treatment Considerations

- Motor-Sensory Disconnect
- Practice in Functional Settings
- Challenge Fast Attention Switching
- Train in safe familiar areas, progress to unfamiliar
- Monitor BP
- Never Fight a Freeze
- Set appropriate goals and give positive feedback

 Cueing Techniques

Basal Ganglia → execution of automatic and repetitive movement
- Damage to the basal ganglia leads to a reduced supply of internally generated movement cues
- External sensory cues are said to bypass the dopamine deficient basal ganglia in people with PD
- External sensory cues are proposed to be able to improve functional performance
- Cues allow information to be rerouted through the nonautomatic pathway

Sensory cueing appears to be a powerful means of improving gait in PD
- Auditory Cuing → improves velocity, cadence, and stride length with sustained long-term improvements
- Visual Cuing → effective in regulating stride length. Horizontal lines can help with freezing
- Attentional Cues → improved balance with external focus vs. internal focus

References:
- Rubinstein TC; 2002
- Nieuwboer A; 2007
- Wulf G; 2009
### Exercise Prescription

**Intensity**

<table>
<thead>
<tr>
<th>BONE RPE</th>
<th>MODIFIED RPE</th>
<th>BREATHING</th>
<th>TRAINING ZONE</th>
<th>% of MHR</th>
<th>TYPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>Very light</td>
<td>1</td>
<td>10% - 15%</td>
<td>RPE1</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>Notice breathing deeper, but still comfortable, conversations possible.</td>
<td>2</td>
<td>15% - 20%</td>
<td>RPE2/FIT</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>Aware of breathing deeper, more effort to maintain conversation.</td>
<td>3</td>
<td>20% - 25%</td>
<td>RPE3/HC</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>Breathing deep and hard, getting uncomfortable.</td>
<td>4</td>
<td>25% - 30%</td>
<td>RPE4/THF</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>Deep and forceful breathing, uncomfortable, don’t want to talk.</td>
<td>5</td>
<td>30% - 35%</td>
<td>RPE5/Max</td>
</tr>
</tbody>
</table>

- **Frequency**

  “Don’t practice until you get it right. Practice until you can’t get it wrong.”

  People with PD who exercised regularly for 2.5 hours a week had a smaller decline in mobility and quality of life over two years.

**Duration**

- 40-75 minutes per session
- Goal of 3 sessions per week
- Continued across a lifetime

**Physical Therapy Needed in All Stages**

- Urgent need for early referral to PT

- Reduced physical activity is seen in Mild PD

- Postural instability & balance impairments can start in H&Y stage 1.5-2

- Mild Cognitive Impairments are seen in early PD

- Early referrals to PT once diagnosed with PD occur <25% of the time
Benefits of Physical Therapy

- Meta-analysis confirmed that PT and exercise can have long term benefits for people with PD
- Balance training has long-term benefits up to 12 months of reducing falls
- Gait training has the second longest effect (up to 6 months of improved walking capacity)
- Future studies needed to determine dose-response effect of exercise with recently diagnosed PD

Exercise Modalities beneficial for PD

- Treadmill Training
- Amplitude Training
- Balance Training
- Functional Skill Training
- Tai Chi
- Tango Dancing
- Boxing
- Forced Cycling
- Resistance Training

Treadmill training in PD

Immediate and long term improvements of gait
- Improved velocity
- Stride length
- Cadence
- Postural stability
- Gait rhythmicity
- Joint excursion

Benefits also translate to improvements in the UPDRS motor score
- Could be due to exercise effects on neuroprotection of dopaminergic neurons

Amplitude training

- LSVT Big and PWR!
- Focus on generation of large amplitude movements involving the whole body
- Incorporates substantial amount of verbal feedback and attention strategies
- Improvement in both movement speed and amplitude → Targets Bradykinesia

Balance Training

- Challenging balance & gait programs improve postural stability in PD
- High intensity program significantly improves scores on BESTest, improved gait speed, improved dual task cost, and balance confidence
- Improvements were maintain at 6 & 12 month follow-up

Functional Skill Training

- Dopamine loss & disease progression correlates most strongly with the severity of bradykinesia
- Bradykinesia interferes most with habitual everyday movements
- Focuses on strength, flexibility, coordination, and balance
- Multimodal practice has greater retention that single mode practice
Nordic Walking
- Whole body activation
- Force-use arm swing
- Cues Posture
- Retrains stride length, gait symmetry, and walking speed
- Increases endurance
- Reduces fear of falling

Progressive Resistance Training
- Amplifies muscle hypertrophy and functional gains
- Long-term improvement in muscle strength, balance, functional mobility, and QOL
- Improvement in off-med UPDRS-III scores found after 24 months
- May have disease-modifying effects

Young PD Treatment Considerations
- Dual Task Training ASAP
- Multidirectional gait changes
- Plyometrics / Agility
- Power Skips

Creativity is intelligence having fun!

Out of the Box Treatment Ideas
Sit-stands with aine, wedge, dynadisc
Scarf toss/batch
Reactive pole drops
Dual task speed ladder drills
Boomwackers for arm swing
1/2 kneel to stand with rotation wall ball slam
Battle rope waves with squats
Split jumps with TRX

Where do we need to go from here?
Group Wellness Programs

“I am lonely” is a variable most correlated with disease progression

- Difficulty consistently performing HEP at home
- Group exercise classes improve balance, QOL, and mood
- Sedentary lifestyle caused by motor symptoms will only worsen balance & gait, which does not respond well to dopaminergic therapy

Wellness Programs

Tai Chi – improved stride length & ↓ falls
- Dynamic postural control
- Engaged cognition
- Boxing
- Rock Steady boxing
- Dynamic balance
- Dancing
- Cognitive engagement of coordination with partner
- Pedal for Parkinson’s
  - Group exercise class at many YMCA’s

Skilled Maintenance Program

- Skilled maintenance therapy is covered in cases that require the skills and judgment of a therapist
- Documentation must clearly show that the services are being provided for maintenance goals as opposed to restorative goals
- Documentation needs to justify the need for skilled therapy to maintain function or prevent/slow deterioration
- Use outcome measures to track status
- POC must reflect the new treatment goals for the patient
- Goals are to slow the decline of function
- Re-assess every 3-6 months once on maintenance program

TAKE HOME MESSAGES

- PT has long-term benefits for people with PD
- PD meds should begin as soon as possible at optimal dosage
- Tremor-dominant PD have more favorable course than PIGD
- PT is necessary at all stages
- Exercise needs to be performed at high intensity levels with large amplitude of movement
- Exercise plays an important role of treating non-motor symptoms
- Cognitive task should be incorporated into treatment
- Wellness programs are needed

Questions?
References


Ahlskog, J. E. (2011). Does vigorous exercise have a neuroprotective effect in Parkinson disease?


Ahlskog, J. E. (2011). Does vigorous exercise have a neuroprotective effect in Parkinson disease?


