Balancing Act: Improving your Mobility and Balance

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Learning Objectives

• Understand the different types of balance systems affected by PD
• Consider how cognitive deficits affect functional mobility in PD and why intense cognitive-agility based exercise may help with mobility
• How to manage freezing and festination with walking
• Learn what physical therapy can do for you!
Why is balance affected?

- Basal ganglia is involved in:
  - Controlling the flexibility of postural tone (Rigidity)
  - Scaling up the magnitude of postural movements (Hypokinesia/Bradykinesia)
  - Selecting postural strategies for the environmental context (Decreased kinesthesia)
  - Automatizing postural responses and gait
  - Executive function

(Park et al, 2015)
Over time, Loss of Dopamine in PD Leads to:

- Rigidity
- Bradykinesia
- Decreased Kinesthesia
- Impaired Executive function
- Freezing of Gait

= Poor balance
Balance Systems

I. Biomechanical Constraints
II. Stability Limits/Verticality
III. Anticipatory Postural Adjustments
IV. Postural Responses
V. Sensory Orientation
VI. Stability in Gait
3 systems contribute to standing balance:
- Somatosensory
- Vision
- Vestibular

Example:
- Walking to the bathroom at night
Anticipatory Postural Control

• Definition: prior to initiation of movement, the body will automatically adjust itself (weight shifting) to maintain center of pressure over the base of support

• Examples:
  • Sit to stand
  • Walking initiation
Decreased Anticipatory Adjustments with Sit to Stand
Individuals with PD demonstrate reduced center of pressure displacement during gait initiation when compared to healthy age-matched controls (Rigoldi et al, 2016)

Individuals with PD demonstrate reduced center of pressure displacement with static perturbations (Park et al, 2015)
Limits of Stability/Postural Sway

- **Limits of stability**
  - Anterior (forward) most limited
  - Causes excessive weight on the heels

- **Postural sway**
  - Abnormal in those with PD, Especially with dual-task distraction
  - Example:
    - Maintaining balance while opening the refrigerator

(Chen et al, 2018)
(Mancini et al, 2012)
Reactive Postural Control

• Definition: automatic movement patterns, or strategies, that occur when balance is disturbed
• Patterns: ankle, hip and stepping strategies
• PD: slower and smaller steps, causing multiple shuffling steps to recover balance
• Common source of falls
• Can improve with training
There are Multiple Circuits Involved in PD

- Due to the defective “auto pilot” of the cortical striatal circuit, PD patients will compensate with fronto-striatal circuit to drive gait (Stuss et al, 2000)
There are Multiple Circuits Involved in PD

Divided Attention
Dual-Task Interference

“Dual-Task Interference”
Walking slows when talk
Talking slows when walk

More difficult in healthy aging & PD:
• Less able to perform multiple tasks
• Difficulty switching between tasks

Neural dysfunction can reduce automaticity of movement, and force locomotion to cortical structures. This puts greater stress on cognitive reserve... thereby increasing dual-task cost.
Dynamic Gait and Dual Task Ability

Balance and Posture:

• Loss of “auto-pilot” due to the area affected by PD (basal ganglia)
  • This is why it is hard to walk and talk to somebody at the same time

• Walking and turning with a dual task slows people with early PD down more than aged matched individuals

• This is tested with dual-task activities in physical therapy
  • Timed up and Go with cognitive task
Stability in Gait

• Freezing of Gait:
  • Why does it happen?
  • Break the Freeze:
    • Look past doorways to a target
    • Use external cues
    • 4 S’s:
      • Stop
      • Stand tall and breathe
      • Shift your weight side to side
      • Step out BIG
    • The more you try to fight the freeze, the worse it becomes

(Cucca et al, 2016)
Incorporating PD and Freezing Specific Cognitive Challenges into Exercise:

- **Dual Task**: ability to complete secondary task during locomotion
- **Set Switching**: shifting attentional focus
- **Conflict Resolution**: ignoring extraneous or incorrect information
- **Response Inhibition**: inhibiting inappropriate and releasing wanted movements

(Peterson et al, 2016)
Physical Therapy

- Recoil Band – eccentric training
- External Cueing – auditory and visual
- Agility/Obstacle Course
- Treadmill training with and without dual task
- Group exercise classes
  - Boxing
  - Tai Chi
  - Group Dance Lessons

Goal = make balance and gait more “automatic”

- Compensations are taught when necessary
Biomechanical Restraints

- Rigidity
- Postural limitations
- Joint range of motion restrictions
- Muscle length restrictions
- Weakness

- **Treatment: flexibility and postural strengthening!**

(Erro et al, 2017)
What Should Physical Therapy Be?

• Treatment should be individualized to fit each person
  • Patient education
  • Accurate/objective baseline balance scores
  • Interests of the patient

• Physical therapist should empower, inspire, and educate the patient on the importance of “the daily dose” for posture, stability, and agility based cognitive and balance training
  • Home exercise program prescription
References:


