

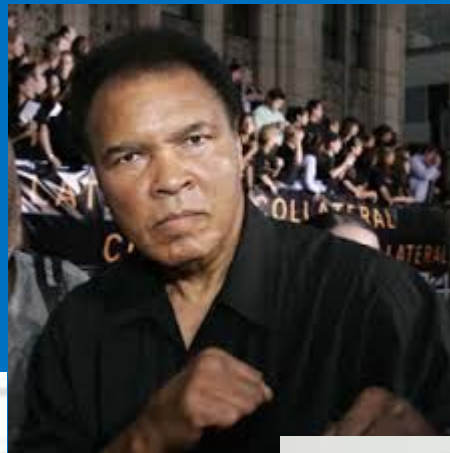
# Parkinson Disease Exercise Prescription

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# Learning Objectives

- 1. Participants will become familiar with evidence based exercise interventions to improve balance and gait and transfers in persons with Parkinson's disease
- 2. Participants will learn techniques people with Parkinson's disease can use to compensate for motor impairments

# Faces of Parkinson's Disease



© 2013 Getty Images

# Parkinson's Disease

- Quick review:
- 2<sup>nd</sup> most common neurodegenerative disease
  - US- 50,000-60,000 new cases of PD are diagnosed each year
  - US -one million people who currently have PD
  - Worldwide- 4-6 million people (NPF)
- Clinical dx
- risk factors
  - Greatest is age
    - Median age of onset 62
    - 4-10% occur before 40 years
  - Genetics- Family history
    - Parkin gene ( autosomal recessive)
      - Implicated in early onset ( 50% w/ family history, 15% w/out family history)
    - LRKK2 ( autosomal dominant)
  - Environment
  - Men affected greater than women

# Parkinson's Disease

- Most affected cells are in Basal Ganglia
  - Automatic pilot (automatic motion in learned motor tasks)
  - fewer neurons in substantia nigra leads to less dopamine released in the striatum
  - 50-60% of neuronal loss when motor symptoms first appear

# Parkinson's Disease

- Movement disorder
- decreased cortical excitability and motor cortical output
- Progressive
- Asymmetric
- Cardinal Symptoms
  - Tremor
  - Bradykinesia
  - Rigidity
  - Postural instability

# UK PDS Brain Bank Criteria to dx PD

- Step 1. Diagnosis of a parkinsonian syndrome (1)
- Bradykinesia and at least one of the following:
  - muscular rigidity
  - rest tremor (4–6 Hz)
  - postural instability unrelated to primary visual, cerebellar, vestibular or proprioceptive dysfunction.

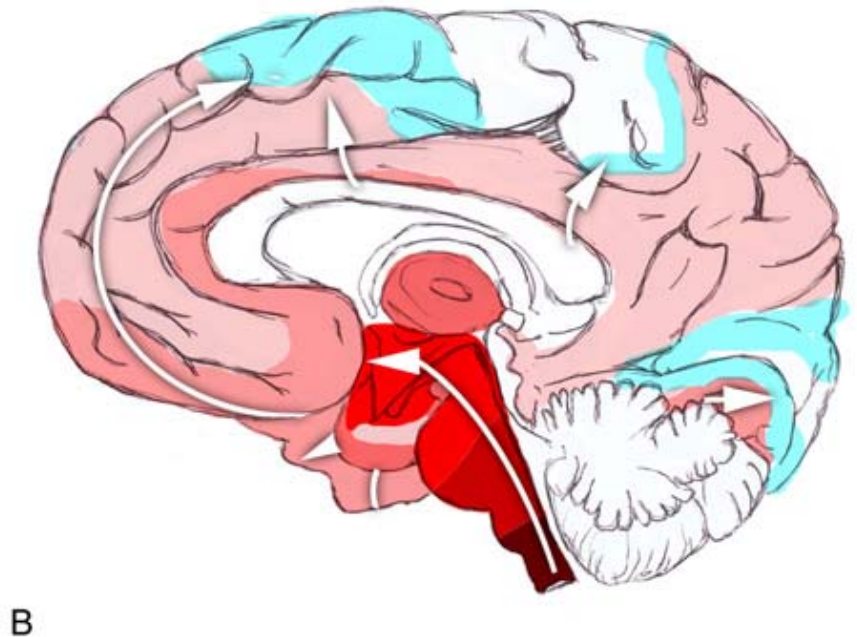
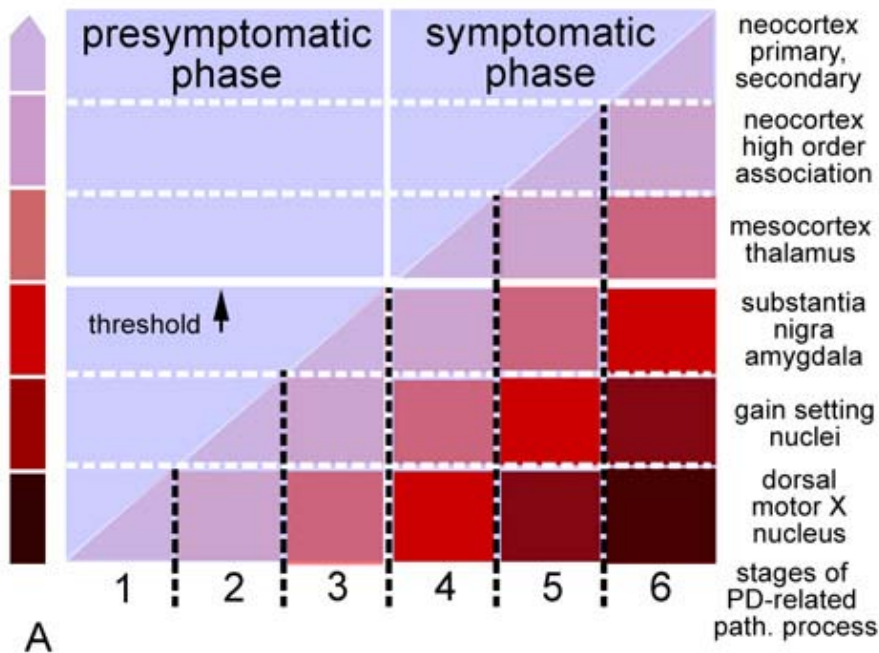
# UK PD Brain Bank Criteria

- Step 2. Exclusion criteria for Parkinson's disease (PD)
- History of :
  - repeated strokes with stepwise progression
  - repeated head injury
  - antipsychotic or dopamine-depleting drugs
  - definite encephalitis and/or oculogyric crises on no drug treatment
  - sustained remission
  - negative response to large doses of levodopa (if malabsorption excluded)
  - strictly unilateral features after 3 years
  - other neurological features: supranuclear gaze palsy, cerebellar signs, early severe autonomic involvement, Babinski sign, early severe dementia with disturbances of language, memory or praxis
  - exposure to known neurotoxin
  - presence of cerebral tumor or communicating hydrocephalus on neuroimaging.



# UK PD Brain Bank Criteria

- Step 3. Supportive criteria for PD
- Three or more required for diagnosis of definite PD :
- unilateral onset
- excellent response to levodopa
- rest tremor present
- severe levodopa-induced chorea
- progressive disorder
- levodopa response for over 5 years
- persistent asymmetry affecting the side of onset most
- clinical course of over 10 years.
  
- Reference:
- (1) [Parkinson's Disease. National clinical guideline for diagnosis and management in primary and secondary care. NICE full guideline.2006](#)



Adapted from Braak H, Ghebremedhin E, Rub U, Bratzke H, Del Tredici K. Stages in the development of Parkinson's disease-related pathology. Cell Tissue Res. 2004 Oct;318(1):121-34.

# Motor and Non-Motor

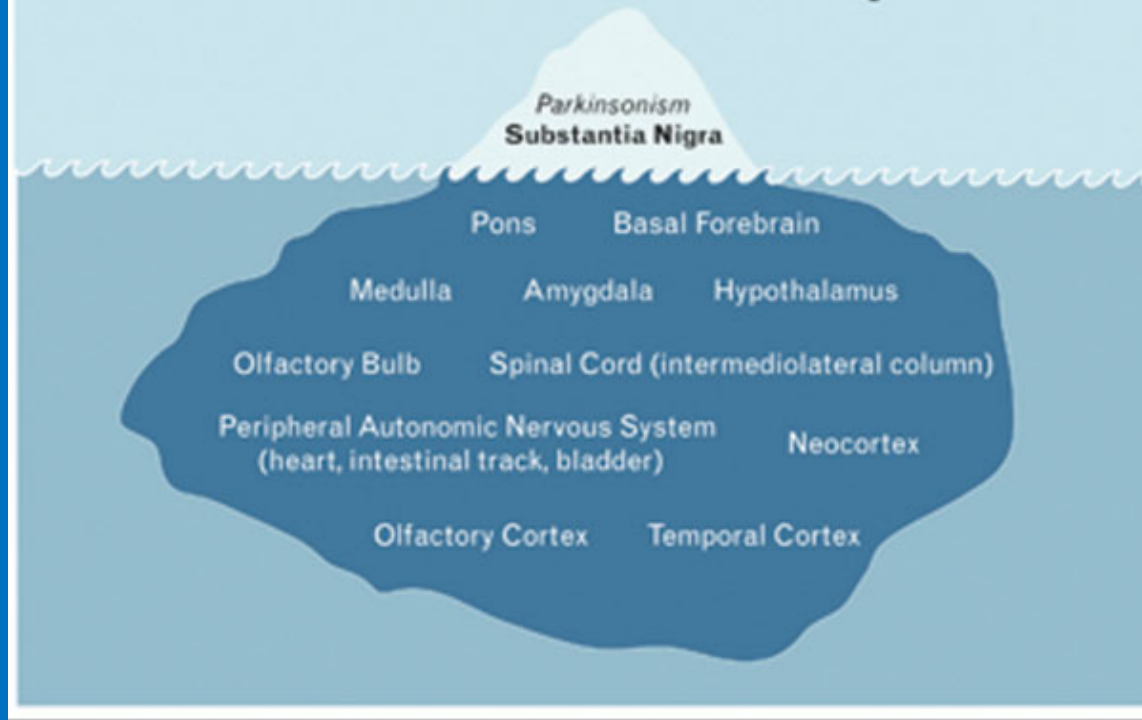
## Motor

- Cardinal Signs
- Masked face
- Flexed posture
- Festination of gait and speech
- FOG
- dyskinesias
- Falls

## Non-motor

- Depression
- Fatigue
- Constipation
- Orthostatic hypotension
- Pain
- Sleep disturbance
- MCI/dementia
- Loss of smell

# The Parkinson's Complex



Langston , W. Annals of Neurology Vol 59 No 4 April 2006

# Hoehn and Yahr

- Staging of PD
- Higher score = greater impairment

# Unified Parkinson's disease rating scale UPDRS

- The UPDRS- part III – motor section
- The UPDRS-III is a collection of 14 items in which an experienced clinician assigns a numerical score, ranging from 0 (normal or no impairment) to 4 (unable to perform or complete).
- assesses the cardinal symptoms of PD: bradykinesia, postural instability and gait dysfunction, tremor, rigidity and akinesia
- Minimal detectable change 5 points

# Functional Gait Assessment

- Reliable and valid
- 10 item test rated 0-3
- Maximum score 30
- Assess walking balance
- Minimal detectable change 4.2 points
- 18/30- optimum predictive for falls in PWP w/in 6 months post hospitalization (Yang et. al. Phys

ther 2014

# Timed up and Go

- Walking mobility skills
- Used w/ mild to moderate PD
- On command stand and walk at a comfortable and safe speed 3 meter turn and return and sit back down
- Minimal detectable change 3.5 sec in PD
- Score > 7.95 sec high fall risk



# Functional Reach Test

- Maximum forward reach in standing w/out taking a step
- MDC 9 cm for PWP
- score  $<31.75$  cm = high fall risk

# Freezing of Gait Questionnaire

- Valid
- Self administered survey
- 6 item
- 5 point ordinal scale
- 0-24 ( no symptoms to severe symptoms)

# Lindop Parkinson's Disease Mobility Assessment

- All tasks are scored on a 0-3 scale with 3 being the best score.
- Maximum score 30
- 6 tasks for assessing gait mobility
- Maximum score 18
  - Sit to stand ( assist)
  - TUG ( timed)
  - Unsupported stand ( timed)
  - 180 degree turn right and left ( # of steps)
  - Walking through doorway ( FOG)
- and 4 tasks for assessing bed mobility
- Maximum score 12
  - Supine to sit ( timed and assist)
  - Sit to supine ( timed and assist )
  - Rolling right and left ( timed and assist)

# Falls

- PWP have balance second strategy
- 2x as likely to fall compared to other neurological conditions
- Fall incidence 38-60%
- 60% of falls occur during medication ON phase
- 70% of PWP who fall do so recurrently
- Recurrent fallers reported 4.7 to 67.6 falls per year

# Treatment

- Medications/Pharmacology
  - Carbidopa/levodopa ( Sinemet ®)
  - Dompamine Agonists
    - Bromocriptine
    - Pramipexole ( Mirapex)
    - Ropinirole ( Requip)
    - Rotigotine (Neurpo)
    - Apomorphine injectable (Apokyn)
  - COMT inhibitors
    - Increase Levodopa “on” time 1-2 hours
    - Entacapone (Comtan)
    - Tolcapone (Tasmar)

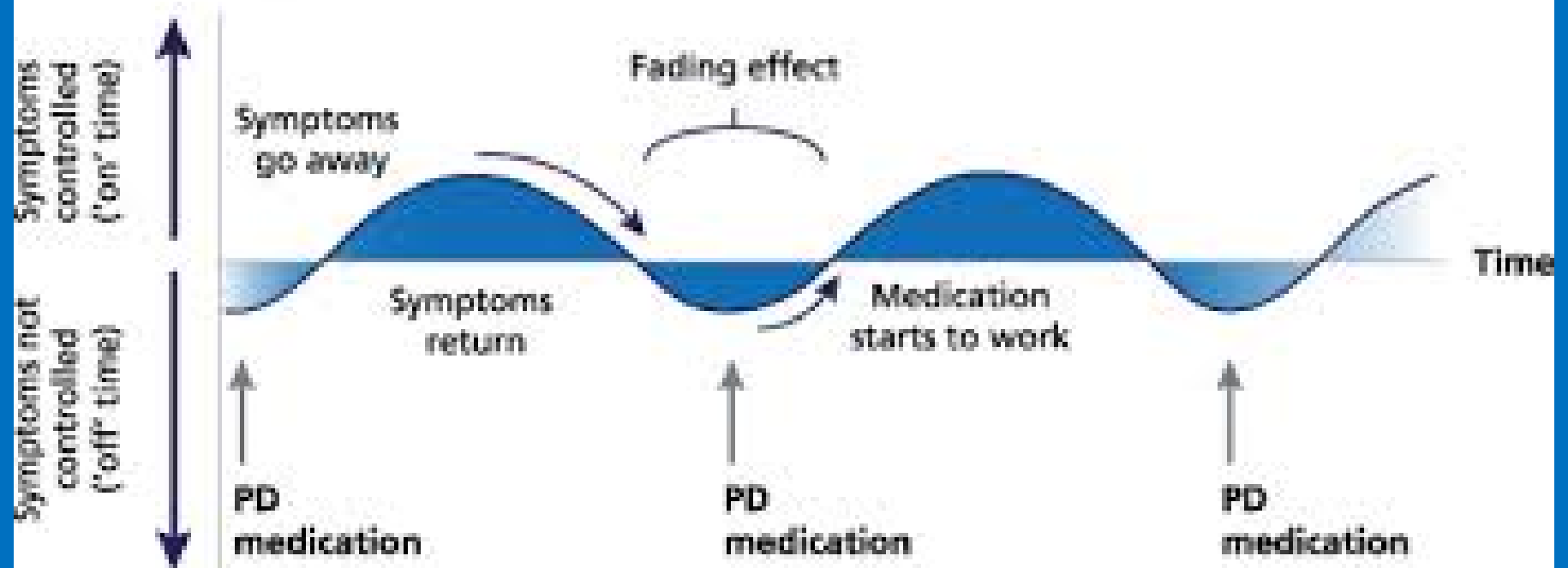
# Treatments

- Monoamine Oxidase Type B Inhibitors (MAO-B)
  - Selegiline
  - Rasagilint (Azilect)
  - Delay levodopa metabolism
  - Use to help manage levodopa wearing off
  - Monotherapy use for mild symptoms
- Anticholinergics
  - Limited effects for tremor
  - Side effects – confusion, dry mouth, urinary retention, blurred vision, constipation
- Amantadine
  - Usual early in PD
  - Mild antiparkinsonism action
  - Later PD may decrease dyskinesias
  - Side effects dry mouth, confusion, constipation, insomnia, agitation, hallucinations, liver disease

# Medication: On/off times

- Need to consider the on and off times of medication when testing, retesting and treating
- Therapeutic window of medication narrows as disease progresses and control of symptoms is difficult w/out causing side effects.
- Exercise can augment the therapeutic window

### A typical day



- <http://www.wearingoff.eu/wearing-off>



# Treatments

- Surgery
  - Pallidotomy
  - Thalamotomy
  - Deep brain stimulation
  - Experimental - Neurotransplantation
- Exercise-

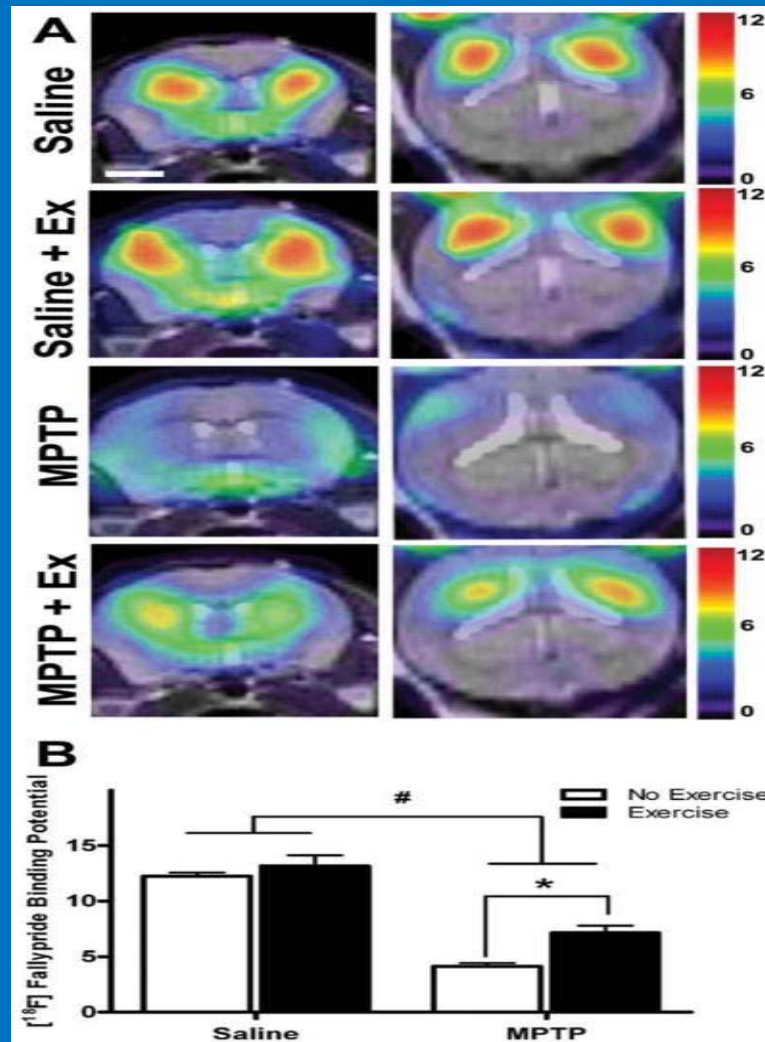
# Animal studies

- Compared 1, 2, and 3 month training pre saline or MPTP injection
- Significant loss of DA neurons w/ 1 and 2 month training 3 month training provided protection against neurotoxicity
- 1/3 and 2/3 of full running for 3 month group- restricted running had significant loss of DA neurons w/ 2/3 group showing partial protection

- Gerecke KM, Jiao Y, Pani A, Pagala V, Smeyne RJ. Exercise protects against MPTP-induced neurotoxicity in mice. *Brain Res* 2010;1341:72–83.

# Animal Studies

- Mouse study compared saline, saline + EX, MPTP, MPTP + Ex
- Treadmill high intensity
- 6 weeks (5 days/week) to reach duration of 60 min/day and speed of 18–20 m/min.
- Behavior: MPTP plus exercise mice had similar maximal treadmill speeds as saline plus exercise mice in week 5 (MPTP plus exercise:  $17.2 \pm 3.6$  m/min and saline plus exercise:  $22.0 \pm 1.5$  m/min) and week 6 ( $19.2 \pm 1.2$  m/min and  $22.2 \pm 0.9$  m/min, respectively)
- MPTP plus exercise mice had 48.8% increase in striatal DA-D2R compared with MPTP mice



Vuckovic, M et, al. Move Disord, 2010: 25(16): 2777-2784.

# LSVT® BIG

- Based on LSVT Loud
- Protocol program
- 16 sessions
- Individual 1 hour sessions
- 4 days a week/4 weeks
- Home exercise program

# LSVT® BIG

- standard whole body exercises - multi-directional repetitive and sustained
- Functional movement and gait
- Maximal amplitude- BIG
- Shaping
- Focus on retraining the motor-sensory disconnect -how big the movements feel

# LSVT® BIG

- Addresses bradykinesia
- Improved movement perception
- Recalibration of scaling of movement-  
Training of amplitude
- training of amplitude results in bigger, faster, and more precise movement

# LSVT® BIG

- Compared LSVT BIG w/ Nordic walking w/ unassisted HEP
- LSVT and Nordic walking received same total dose of therapist time ( 2x /wk x 8 weeks) 4-6 person group
- HEP -HOME received a 1-hour
  - instruction of training with practical demonstration and training. Exercises included stretching, high-amplitude movements
- 58 subjects H and Y I-III
- Measure UPDRS III, TUG, 10 meter walk, PDQ -39
  
- Ebersbach , G., et al. Comparing Exercise in Parkinson's Disease—The Berlin LSVT BIG Study. Movement Disorders 2010



# LSVT® BIG

- LSVTBIG led to significant improvement motor performance UPDRS III score (mean 5.05) , timed 10 meter walk, and TUG in patients with PD
- No significant difference in PDQ 39
- UPDRS motor score did not improve in patients with training in Nordic walking or in patients receiving a single 1-hour-instruction for home training by a therapist
- Ebersbach , G., et al. Comparing Exercise in Parkinson's Disease—The Berlin LSVT BIG Study. Movement Disorders 2010

# LSVT® BIG

- 3 person case study H and Y I-III
- Pre and post test
  - FGA, TUG, FRT, FOGQ, UPDRS III, LPA, 9HPT,
- Results
- FGA- increased ( did not exceed MDC)
- FRT – increased ( 2/3 achieved MDC)
- TUG – decreased ( did not achieve MDC)
- FOGQ- improved in one subject
- UPDRS III- improved ( 2/3 achieved MDC)
- LPA ( B) – ceiling affect at initial testing
- 9HPT- improved non-dominant hand ( 2/3 achieved MDC), no change in dominant hand
- Janssens, J., et. al. Application of LSVT BI G intervention to address gait, balance, bed mobility, and dexterity in people with Parkinson disease: a case series. Phys. Ther. 2014.

# Video

- 71 year old man
- <http://www.brainmattersllc.com/lsvt-bigtrade-therapy-for-parkinsons-disease.html>

# Forced Exercise- Tandem bike

Rational- PD has decreased cortical activation and impaired sensory motor integration

- study compared forced use to voluntary ex. ( 10 subjects)
  - Comparison of self selected pedaling to forced use pedaling (30% greater than self selected)
  - 1 hour sessions 3x/wk x 10 wk “on medication”
  - 10 min wu and cd w/ 40 min main set ex
  - Intensity set at (60-80% of THR) ( ACSM recommendations)
- Total work:
  - PWP- 25-30% of total work
  - Trainer 75% of total work
- UPDRS part -III motor @ baseline groups equal



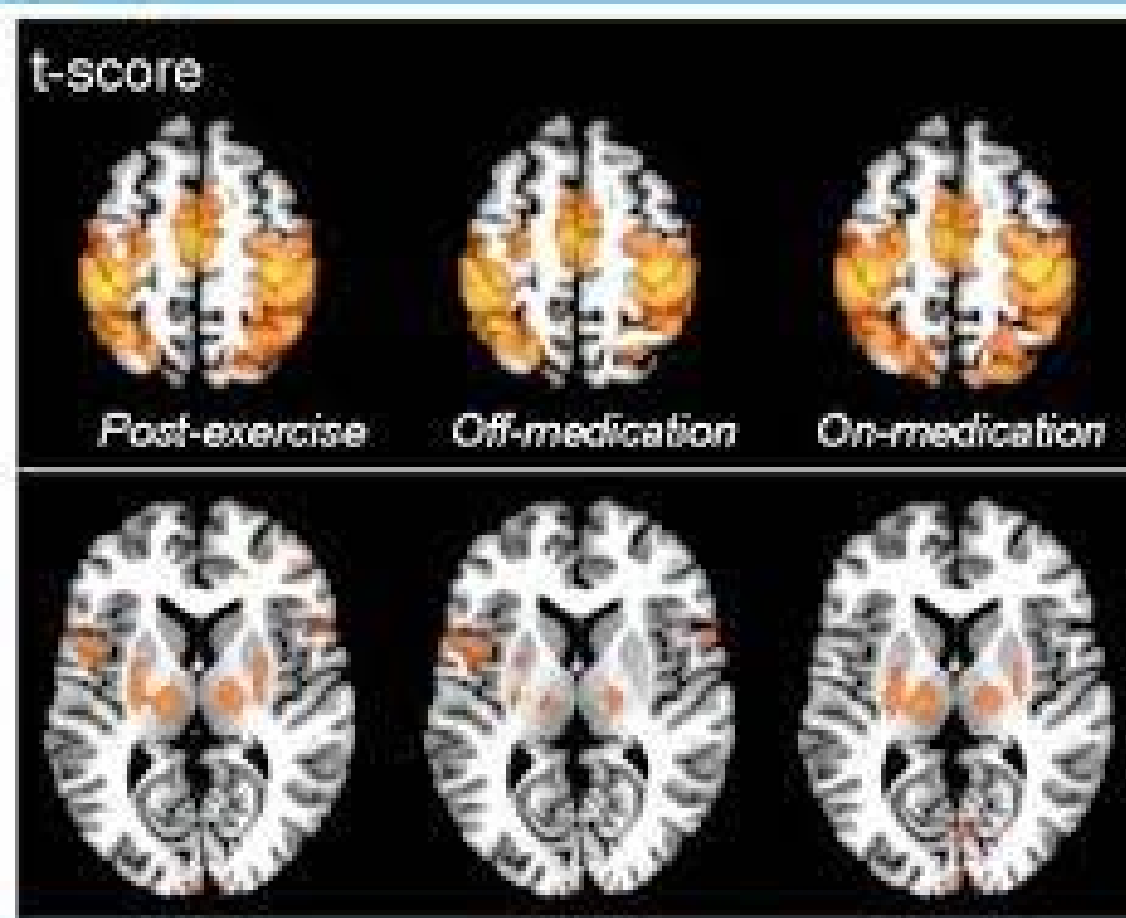
# Forced Exercise – Tandem Bike Results

- VO2 Max increased in both groups – exercise improves fitness improved
- UPDRS III score:
  - end of treatment FE significant improvement (35% ) compared to baseline, self selected no change
  - End of treatment + 2 wks FE significant improvement ( 28%) compared to baseline
  - end of treatment + 4 wks FE non significant 5% improvement compared to baseline
- the grip-load relationship also tested ( bimanual task)
  - Pre test -irregular and inconsistent from trial to trial.
  - Self selected pace exercise did not improve coupling of grasping forces for either limb.
  - FE after 8 wk - grip-load coupling of patients with PD became more linear,
  - Improved coupling of grasping forces persisted for the FE group 4 wk after exercise cessation.

# Forced Exercise –Tandem Bike/ Results

- MRI- blood flow activation patterns
- off meds, on meds, post FE off meds
- 9 subjects studied
- Areas examined: bilateral putamen, globus pallidus, thalamus, primary motor, and supplementary motor area
- Imaging data indicate a significant correlation between FE and medication for regions in the basal ganglia and cortex.
- UPDRS-III ratings decreased 35% after FE and 32% on medication compared with off medication

Microscope



Source: Exerc Sport Sci Rev © 2011 American College of Sports Medicine



# Forced Exercise-Tandem bike

- Results:
  - Forced-exercise group pedaled 30% faster and produced 42% less work compared to the voluntary exercise group
  - Tremor and handwriting had short term improvement
  - Improved sense of smell reported

- Albert, J., *Exerc Sport Sci Rev.* 2011

# Recommendations for forced exercise

- Consult cardiologist and movement disorders specialist
- Ex at 65-85% of  $VO_2$  max HR or age determined
- Reduce resistance and increase rate
- Augment don't replace voluntary effort

# Treatment w/ Exercise

- Early intervention is important
- Pre- clinical phase –Neuro-protection
- Early to moderate phase – Neuro-repair
- Late phase – compensation
- progressive aerobic training should be encouraged
- PD physical therapy programs should include structured, graduated fitness
- PD medication should be used to used to maximize the PWP ability to participate in physical activity and maximize physical fitness

# Sparx study

- Currently underway
- Funded by NIH
- Multicenter study –University Pitt, Chicago, Colorado
- To determine correct exercise intensity
- Comparing 60-65% max HR, 80-85% max HR to no exercise
- 4x/wk x 6 mos.
- **Subjects: recent PD dx w/ no medication**
- Moore et al. Study in Parkinson Disease of Exercise (SPARX): Translating high-intensity exercise from animals to humans. Contemporary Clinical Trials

# Compensation techniques

- Rhythmic Auditory Cues
  - Use rhythm to set cadence
  - -rhythm is interval perception
  - Rhythm allow for anticipation
  - Music
  - Metronome
  - Enhance and entrain a rhythmic movement pattern
  - Activate motor cortex and premotor cortex
  - Bypass the basal ganglia
  - Have to listen to beat while simultaneously performing the – difficult for dual task

# Rhythmic Auditory Stimulation

- Thaut, Mov Disorders , 1996
  - 3 week training
  - No training , self paced, experimental
  - experimental group improved step length and cadence
- McIntosh et. al. Move. Disorders 1998
  - Measured velocity pre, post and f/u
  - Decline in progress made at 4 wks
- Neuwboer, J. Neurol. Neurosurg psych 2009
  - H and Y stage- 2-4
  - RAS : with prototype device
  - 3 week w/ device compared to no device
  - Cross over design w/ 6 week f/u testing
  - Cadence increased by 10% to 112-116 /min
  - Decrease freezing, step length increased by 4 cm, fall efficacy improved
  - Effects significantly decreased at 6 week f/u testing

# Compensation techniques

- RAS assessment
  - Determine current cadence
  - Start rhythm at baseline step rate
  - Increase rate and observe gait quality, may need to decrease
- Visual Cues
  - Tapped lines in door way
  - “x” on floor
  - Laser pointer
  - Care partner foot to step over

# Compensation techniques

- Tactile
  - Tap foot w/ cane
  - Care partner taps patient



# Equipment

- Hiking Poles/Nordic walking
  - Increases energy expenditure by 30%
  - Reciprocal arm swing
  - Can help w/ joint pain
  - 6 wk program showed improved walking, balance and QOL scores
  - Movement disorder, 2008
- Buddy
  - cues PWP when posture is excessively bent forward
  - contains a metronome select audio and/or vibrate feedback.
- U- step walker
  - Heavy frame
  - Reversible brake
  - Laser pointer
  - Coded differently than other walkers/ may not also cover W/C
- Theracycle
  - Motorized bicycle
  - Based on tandem bike forced exercise studies

[www.2mel.nl/parkinson-buddy](http://www.2mel.nl/parkinson-buddy)



[www.ustep.com](http://www.ustep.com)

1-800-558-7837



[\*www.theracycle.com\*](http://www.theracycle.com)



# Other programs

- Artful Actions Movement and voice exercises are adapted from theater and dance – John Argue
- Parkinson's Wellness Recovery (PWR)- research-based exercise techniques to target the specific motor and nonmotor symptoms of PD. Becky Farley, PT
- Help PD- constraint-focused agility exercise program Fay Horak PT

# Resources

- NPF- <http://www.parkinson.org>
- Michael J. Fox Foundation-  
[www.michaeljfox.org](http://www.michaeljfox.org)
- *Parkinson Disease Foundation-*  
[www.pdf.org](http://www.pdf.org)
- *Davis Phinney Foundation-*  
[www.davisphinneyfoundation.org/](http://www.davisphinneyfoundation.org/)



Happy Thanksgiving  
Questions?

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