Vibration & Parkinson's disease? (motor symptoms - gait and tremors)

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Objectives

- Gait and mobility issues - what I learned from research and people with Parkinson's
- Research: vibration in the treatment of "freezing of gait"
- New applications of vibration – tremor
- Future research

What PD looks and feels like

- Motor symptoms include:
  - Tremor, rigidity, akinesia and postural instability
- Non-motor symptoms include:
  - Anxiety, depression, muscle weakness, GI problems, sleep issues, vision problems, decreased cognition…and the list goes on!
- ALL of the symptoms → decreased function

Research focus: Gait issues

PD gait can be:

- Slow
- Shuffling
- Freezing of gait – (> 50% of PD population)
  - Start hesitation
  - Turn hesitation
  - Apparent hesitation in tight quarters (doorways)
  - Destination hesitation (when approaching a target)
  - Open space hesitation

(Schaafsma et al, 2003)

Treatment for Gait Disturbances

- Medication
- Surgery, not for everyone
- Tricks of the Trade[1]
- External cueing
  - Visual
  - Auditory
  - Tactile
  - Vibratory

[1]**Pretzer-Aboff, I.,** Galik, E., & Resnick, B. (2009). Barriers and facilitators to optimizing function in the Parkinson's patient. *Rehabilitation Nursing, 34*(2), 55-63

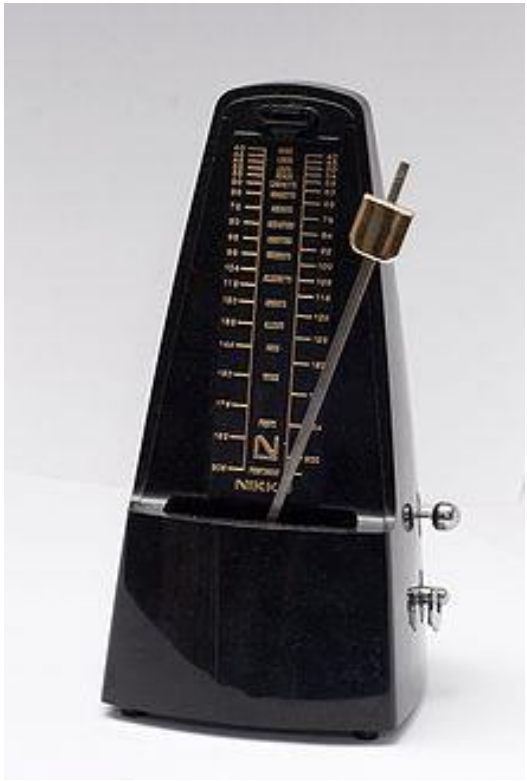
Tricks to thaw the "Freeze"…

- Humor, distraction
- Avoid small spaces
- Clear path of clutter
- Visualization
- Lift toes
- Patience – **"wait for freeze to thaw"**
- **Rushing** can trigger a freeze!

[1]**Pretzer-Aboff, I.,** Galik, E., & Resnick, B. (2009). Barriers and facilitators to optimizing function in the Parkinson's patient. *Rehabilitation Nursing, 34*(2), 55-63

Visual Cues

Auditory Cueing



- Mixed results
  - Improves the preparation of gait initiation, not its execution (Delval, 2013)
  - Improves gait and mobility in the home (Rescue trial, 2010)

The touch…. tactile

A vibratory shoe?

- The story….

A vibratory shoe?

- Evidence (Lauren et al, 2009; Ghosein, 2009; Novak, 2006)
- Teams:
  - UD: Engineers: Dr. Sunil Agrawal, Dr. Kyle Winfree, Nurse scientist: Dr. Ingrid Pretzer-Aboff
  - India: Neurologist: Dr. Behari, physical therapists and neuro nurses
- Built a prototype of a shoe in the UD Robotics Rehabilitation Lab

PD SHOE …. FIRST PROTOTYPE

India I study

- Site: All India Institute of Medical Sciences (AIIMS), Delhi, India – India IRB approved
- Purpose: test the efficacy of the PDShoe on people with PD
- Hypothesis:

  1) the PD subjects would show improvement in gait and clinical scores over the course of the therapy

  2) the PD shoe would be able to resolve differences in gait between healthy and PD subjects

Protocol

Each of the 8 subjects:

- 9 sessions of walking in one week
- Morning and afternoon sessions
- Rest periods lasting 2-5 minutes between bouts of walking

2min_6min_6min_6min_2min


DELL

Demographics –PD subjects (8)

- Age: mean 61.5 y.o. (SD=12.2), range: 48-86
- Male: 75%, (N=6)
- Hoehn & Yahr stage: median 3, range: 1.5-3
- Five had FOG, Two had DBS

Outcome Measures

- 6 measurements directly from the shoe
- Berg Balance Scale (BBS)
- Timed Up and Go (TUG)
- Freezing of Gait questionnaire (FOG-q)

- Collected data on healthy subjects too

Results - Hypothesis #1:

Improvement in gait and clinical scores post therapy

Measure	Group Mean(SD)	Group Mean(SD)	Pre vs Post	
	Pre	Post	Change	*p*
FOG - q	11.00 (6.15)	10.38 (6.74)	better	0.87
Berg Balance Scale	48.13 (7.53)	52.13 (2.95)	better	0.18
Timed Up &Go	12.62 (4.10)	9.90 (0.96)	better	0.09

Hypothesis#2 : Gait would be more normal after vibration intervention

	Step duration	Stance duration	Swing duration	Stance to swing ratio	Heel duration
PD006	=	=	=	=	=
PD007	=	=	=	=	=
PD008	+	+	+	+	+
PD009	-	=	=	=	=
PD010	-	=	=	+	=
PD011	-	=	=	+	=
PD012	+	-	-	?	+
PD013	=	+ (*p=.055*)	+	+	-

Interestingly….

- All 5 of these subjects (PD008, 010, 011, 012, 013) scored 8 or higher on baseline FOG-questionnaire (0-24 scale with higher numbers indicating worse FOG).
- Two subjects (PD011, PD012)had Deep Brain Stimulators
- *PD008 was significantly better post treatments*

SUBJECT PD008 PRE/POST 8 TREATMENTS

- https://vcu.mediaspace.kaltura.com/media/Clip+of+Vibration+Therapy+for+Freezing+of+Gait+in+Parkinson+1.25.2017/1_bzlx6kdc

India II study

- Included 17 subjects with FOG
- Study design is one PDShoe session per day spread out over the course of 2 weeks
- Significant improvement in disability scores (UPDRS III), mobility (TUG), balance (BBS), fall efficacy (FES-I), and quality of life (PDQ).

Aggarwal, R., Pretzer-Aboff, I., Winfree, K.N et.al (2019). Clinical outcomes of step-synchronized vibration training in Parkinson's disease patients with freezing of gait. Annals of Movement Disorders.

University of Delaware – Study 3

- Continuous vibration stimulus (a more cost-effective system)
- 12 enrolled, all with FOG
- 2 x daily, for 4 days over one week.
- *Results indicated significant improvement in:*
  - PDQ-39 mobility score (p=.01)
  - UPDRS part III - spontaneity of movement (p=.005),
  - UPDRS Part 1 total score (p<.001)
  - H&Y staging (p=.04).
  - Mean FOG Q scores improved (pre = 8.92, post = 6.92) but not statistically (p=.13).
  - The subjects reported comfort of vibration, and no falls or safety issues were reported.

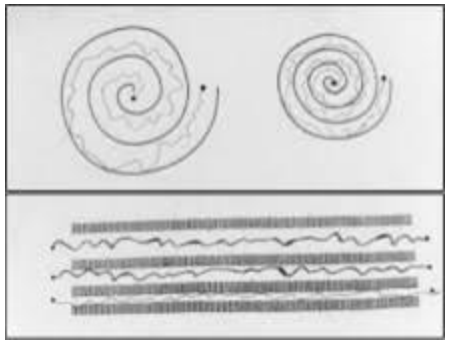
VCU - MJFF Study - present

Current Research Activity

- MJFF funded a two-year study $440K
- Phase I we will investigate optimum vibrations settings and duration of treatment – **recruiting now**
- Phase II we will test in randomized controlled trial.

Second Study – Vibrations Impact on PD Tremor

- + Resonate Forward LLC
- + College of William & Mary
- Effect of vibration on tremor, comfort, input from participants



- Recruiting now
- Vibration on one arm
- 1-2 hours
- One visit
- NOW center

Third Study – PDSock
Design and Development of PDSock!

- VCU - Innovation Grant SON and Langston Center
- + VCU Fashion, Design & Marketing
- + Resonate Forward, LLC

- **Goal: Design & Development of a PDSock that allows the vibration device to be worn in the community setting.**

PD SHOE PRESENT….

PD SOCK…. FUTURE

Thank you!