# Balance and Falls in Parkinson's Disease

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Updates in Parkinson's Disease
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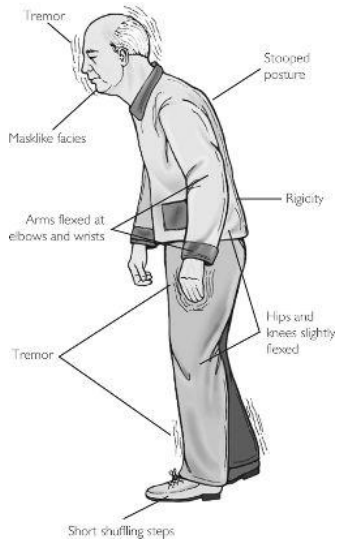
## Falls and Parkinson's disease

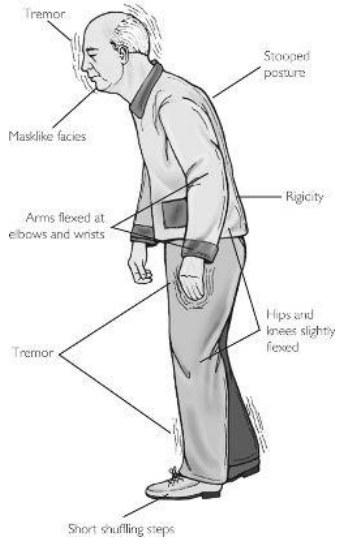
- Falls:
  - Major problem in PD
  - 70% of people with PD have at least one fall per year
  - Financially costly:
    - 2nd most common reason for hospitalization
    - Cause of 1/3 of nursing home admissions
  - Worsening physical mobility is most important single factor contributing to decline in quality of life in PD

## Four Cardinal Feature of PD




1. Tremor
2. Slowness
3. Rigidity (Stiffness)
4. Postural Instability

## Four Cardinal Feature of PD



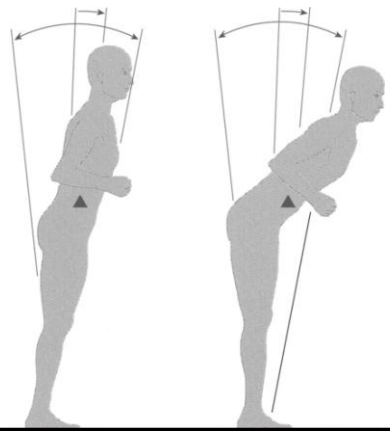

1. Tremor
2. Slowness
3. Rigidity (Stiffness)
4. **Postural Instability**

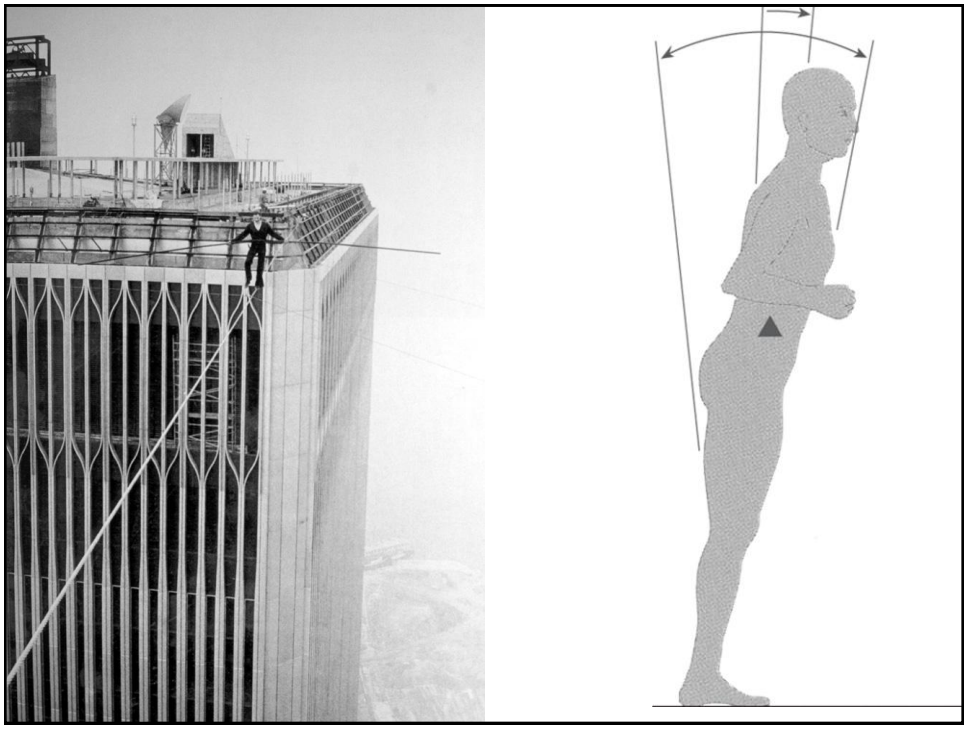
## Postural Instability is a Unique Feature

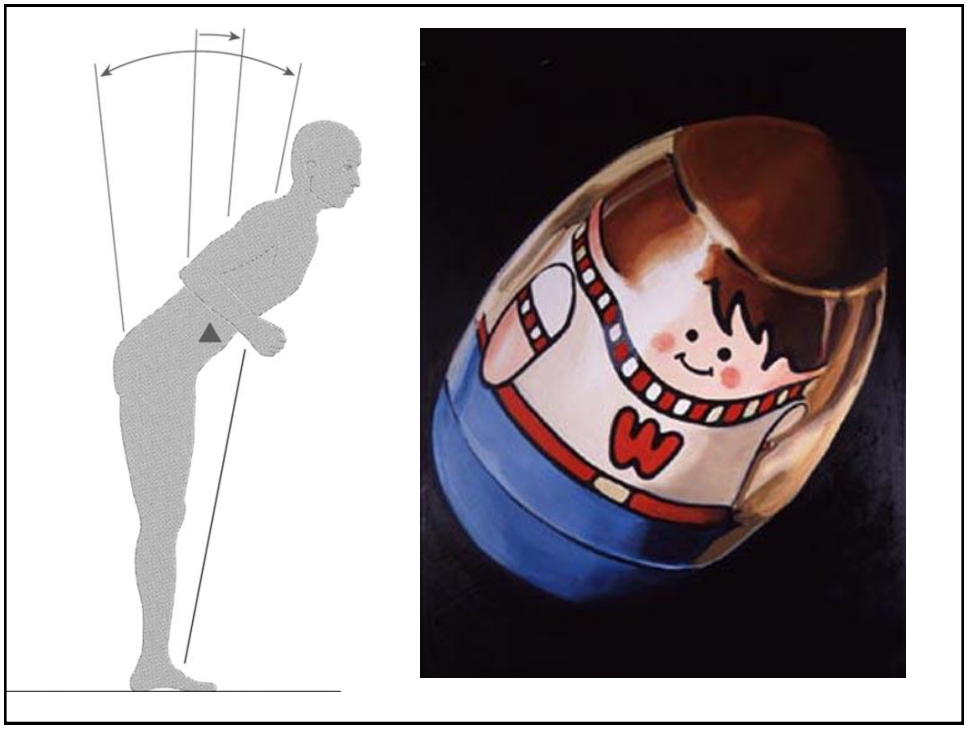
- Usually presents a few years into the disease
- Is not generally as response to dopamine medications (levodopa, ropinirole, pramipexole…)

## Balance is complex

- Good balance is simplistically the ability to maintain your center of balance within your limits of stability







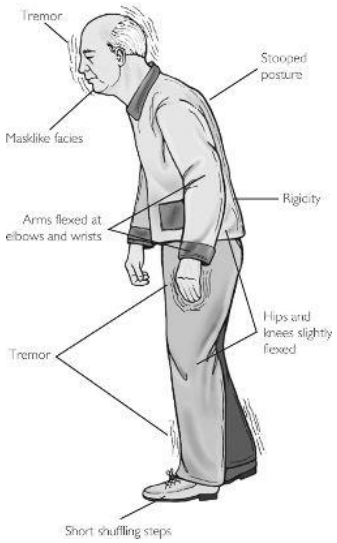
## Hoehn and Yahr PD Stages

- 0: No signs of disease.
- 1: Unilateral symptoms only.
- 1.5: Unilateral and axial involvement.
- 2: Bilateral symptoms. No impairment of balance.
- 2.5: Mild bilateral disease with recovery on pull test.
- 3: Balance impairment. Mild to moderate disease. Physically independent.
- 4: Severe disability, but still able to walk or stand unassisted.
- 5: Needing a wheelchair or bedridden unless assisted.

## Balance is Extremely Complex

Effected by other PD features:

- Stooped posture
- Shuffling gait
- Slowness of stepping
- Slowness/decreased arm movements



## Balance is Extremely Complex

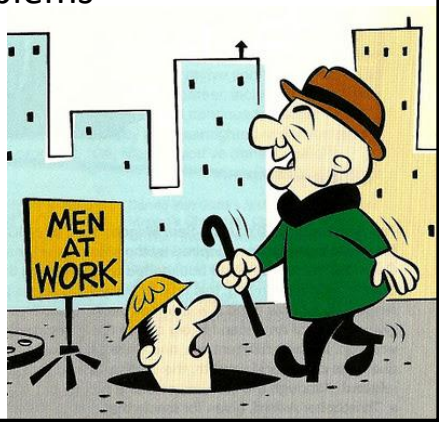
Effected by abnormality in balance itself:

- Automatic postural responses
- Anticipatory postural responses
- Defective somatosensory pathways

## Balance is Extremely Complex

Effected by complications of medications and other medical problems:

- Confusion/ Memory problems
- Dyskinesias
- Vision problems
- Neuropathy (numb feet)



# Balance Testing

- Clinical testing
  - Most commonly we do a pull test

# Balance Testing

- Questionnaires

**FIGURE 2.** The Activities-Specific Balance Confidence (ABC) Scale

Rate each item on a scale of 0% (no confidence) to 100% (complete confidence), indicating your confidence in performing the task without losing balance or becoming unsteady.

| | |
|---|---|
| Ride escalator holding rail | _____ |
| Ride escalator not holding rail | |
| Get in/out of car | _____ |
| Pick up slipper from floor | |
| Reach at eye level | _____ |
| Reach on tiptoes | _____ |
| Stand on chair to reach | _____ |
| Sweep the floor | _____ |
| Walk across parking lot | _____ |
| Walk around the house | |
| Walk in crowd/bumped | _____ |
| Walk in crowded mall | _____ |
| Walk on icy sidewalks | _____ |
| Walk outside to nearby car | _____ |
| Walk up and down ramp | _____ |
| Walk up and down stairs | _____ |

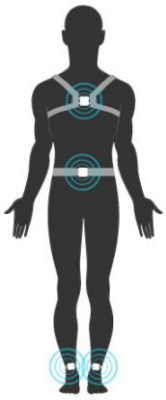
Score

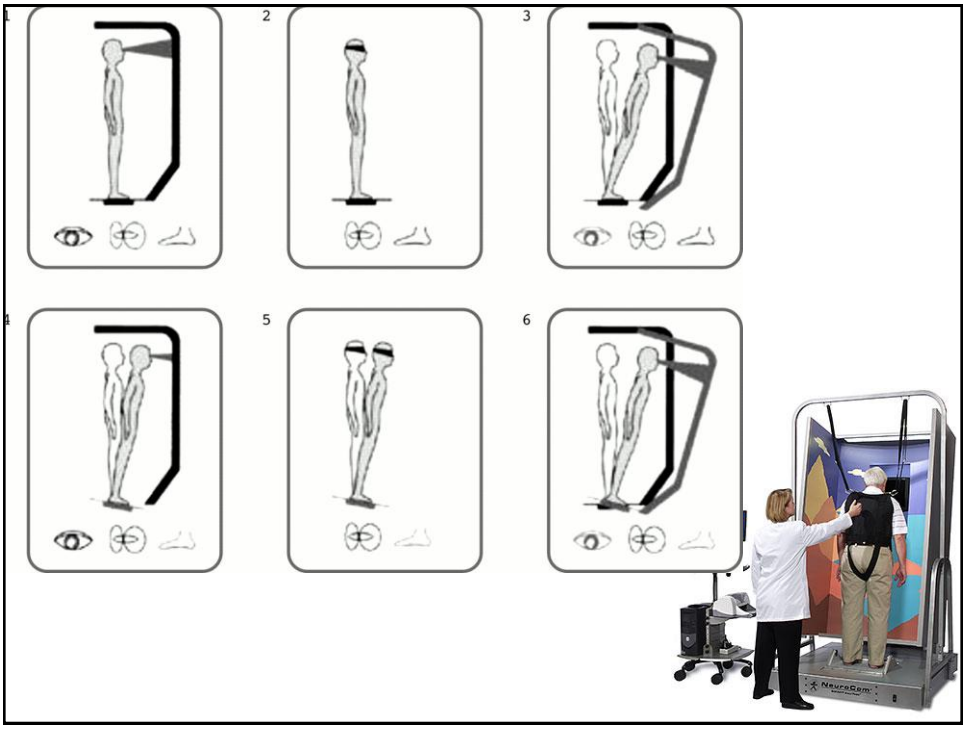
Average the responses to the questions to obtain a percentage score, with lower scores being indicative of less confidence in task performance (ie, greater perceived handicap).

Data from Powell LE and Myers AM.[4]

# Balance Testing

- More in-depth computerized testing



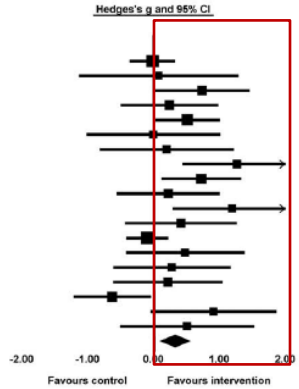



# Treatment - Exercise

Balance-related activities (n = 747)

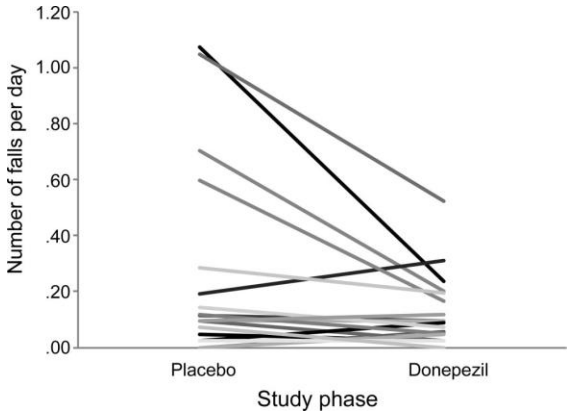
| Study name | Outcome | Statistics for each study | | | |
|---|---|---|---|---|---|
| | | Hedges's g | Lower limit | Upper limit | p-Value |
| Ashburn, 2007 | Berg Balance Scale | -0.010 | -0.348 | 0.328 | 0.952 |
| Blackinton, 2002 | Timed Up and Go (expanded version) | 0.081 | -1.125 | 1.287 | 0.895 |
| Caglar, 2005 | Gait time | 0.742 | 0.021 | 1.463 | 0.044 |
| Cakit, 2007 | Berg Balance Scale | 0.245 | -0.491 | 0.981 | 0.514 |
| Ellis, 2005 | Gait velocity | 0.515 | 0.027 | 1.004 | 0.039 |
| Fisher, physiotherapy, 2008 | Gait velocity | 0.000 | -1.010 | 1.010 | 1.000 |
| Fisher, treadmill, 2008 | Gait velocity | 0.205 | -0.808 | 1.218 | 0.692 |
| Hackney, 2008 | Berg Balance Scale | 1.271 | 0.450 | 2.092 | 0.002 |
| Hackney, 2009 | Berg Balance Scale | 0.731 | 0.131 | 1.331 | 0.017 |
| Kurtais, 2008 | Gait time | 0.229 | -0.547 | 1.004 | 0.563 |
| Mak, cues, 2008 | Sit to Stand Time | 1.198 | 0.298 | 2.098 | 0.009 |
| Mak, exercise, 2008 | Sit to Stand Time | 0.421 | -0.426 | 1.268 | 0.330 |
| Nieuwboer, 2007 | Timed Up and Go | -0.091 | -0.407 | 0.224 | 0.570 |
| Protas, 2005 | Gait velocity | 0.483 | -0.411 | 1.377 | 0.290 |
| Sage, aerobic, 2009 | Timed Up and Go | 0.282 | -0.602 | 1.167 | 0.531 |
| Sage, SAFEx, 2009 | Timed Up and Go | 0.223 | -0.604 | 1.050 | 0.597 |
| Schenkman, 1998 | Gait time | -0.622 | -1.204 | -0.040 | 0.036 |
| Thaut, walk with cues, 1996 | Gait velocity | 0.919 | -0.031 | 1.870 | 0.058 |
| Thaut, walk without cues, 1996 | Gait velocity | 0.515 | -0.501 | 1.530 | 0.320 |
| | | 0.331 | 0.111 | 0.552 | 0.003 |

$I^2 = 47\%$, $P = 0.013$




# Treatment - Medication

Fall frequency is reduced during donepezil use



## Research – Balance & Falls

- Multiple studies looking at this topic
  - Exercise interventions (home vs. individual vs. group based)
  - Donepezil intervention
  - Freezing and mental function
  - Vitamin D
  - Balance (in PSP)

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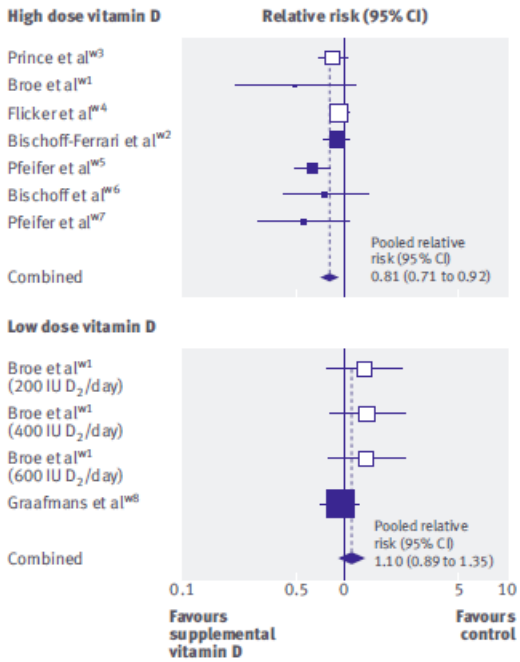
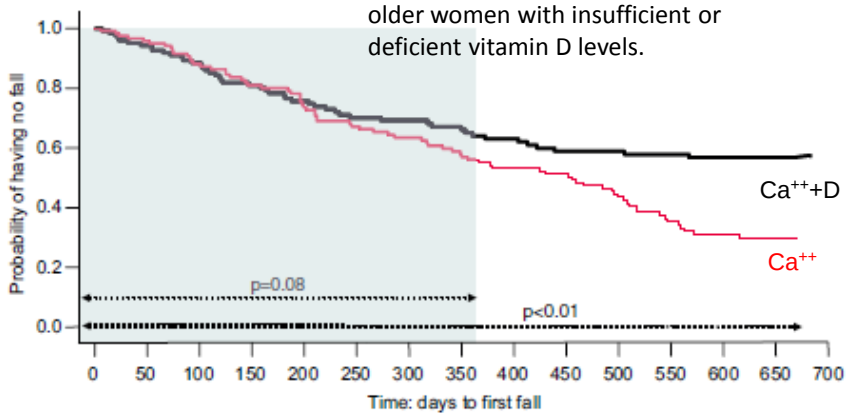
# Vitamin D probably reduces falls in elderly fallers




Bischoff-Ferrari HA, Dawson-Hughes B, Staehelin HB, Orav JE, Stuck AE, Theiler R, Wong JB, Egli A, Kiel DP, Henschkowski J. Fall prevention with supplemental and active forms of vitamin D: A meta-analysis of randomised controlled trials. BMJ 2009;339:b3692.

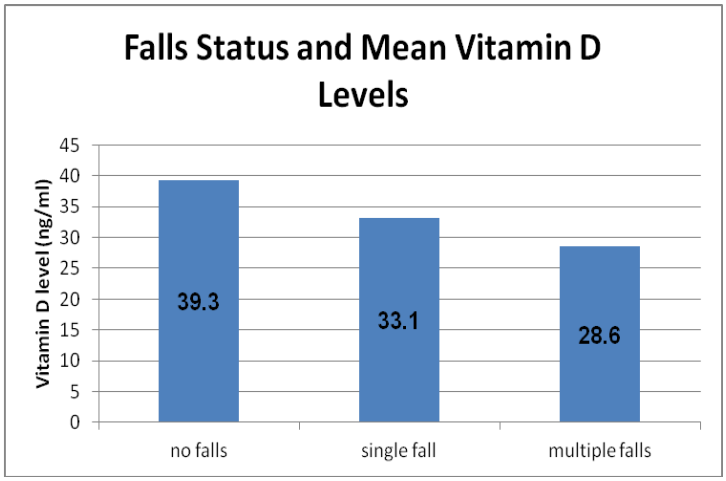
# Vitamin D and Falls

Prospective study with falls as primary outcome. Population was older women with insufficient or deficient vitamin D levels.




Pfeifer M, Begerow B, Minne HW, Suppan K, Fahrleitner-Pammer A, Dobnig H. Effects of a long-term vitamin D and calcium supplementation on falls and parameters of muscle function in community-dwelling older individuals. Osteoporosis Int 2009 Feb;20(2):315-22.

# Vitamin D and Falls




**Data from: Intelligent Systems for Assessment of Aging Changes Study (ISAAC)**

# Vitamin D and balance

- Vitamin D may improve in sway/balance

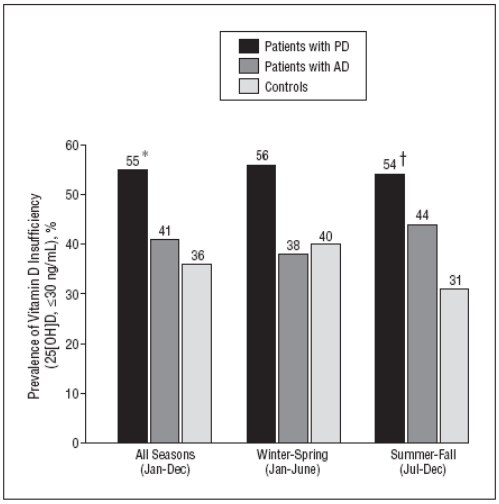
TABLE 3. INITIAL BODY SWAY PARAMETERS AND CHANGES AT 8 WEEKS IN 148 STUDY SUBJECTS, ACCORDING TO STUDY GROUP (INTENTION-TO-TREAT)

| *Index and study group* | *Initial value* | *Change* | P-*value* |
|---|---|---|---|
| Body sway frontal diameter (mm) | | | |
| Calcium mono | 12.8 ± 9.3 | −1.7 ± 11.0* | |
| Calcium-vitamin D | 13.3 ± 9.2 | −3.2 ± 8.7* | |
| Body sway saggital diameter (mm) | | | |
| Calcium mono | 17.0 ± 6.8 | +0.4 ± 8.0 | |
| Calcium-vitamin D | 17.0 ± 6.2 | −1.1 ± 7.6 | $P = 0.0435^{\dagger}$ |
| Body sway area ($mm^2$) | | | |
| Calcium mono | 148.5 ± 157.9 | −24.3 ± 163.2* | |
| Calcium-vitamin D | 149.6 ± 151.1 | −47.1 ± 135.4* | |

Values are the mean ± SD.
* $P < 0.001$ (probability for a population mean of 0 by the Wilcoxon test by chance alone).
† *P*-Value represents the probability of the difference between the two treatments.

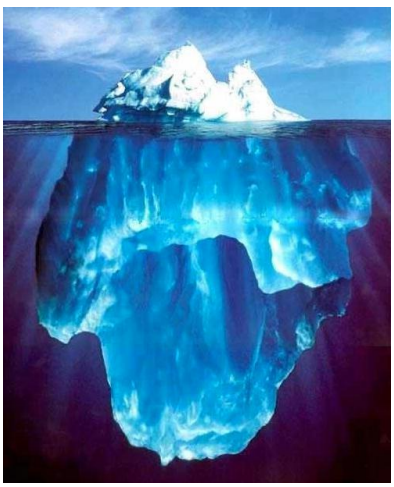
Pfeifer M, Begerow B, Minne HW, Abrams C, Nachtigall D, Hansen C. Effects of a short-term vitamin D and calcium supplementation on body sway and secondary hyperparathyroidism in elderly women. Journal of Bone & Mineral Research 2000 Jun;15(6):1113-8.

# Vitamin D is low in Parkinson's disease



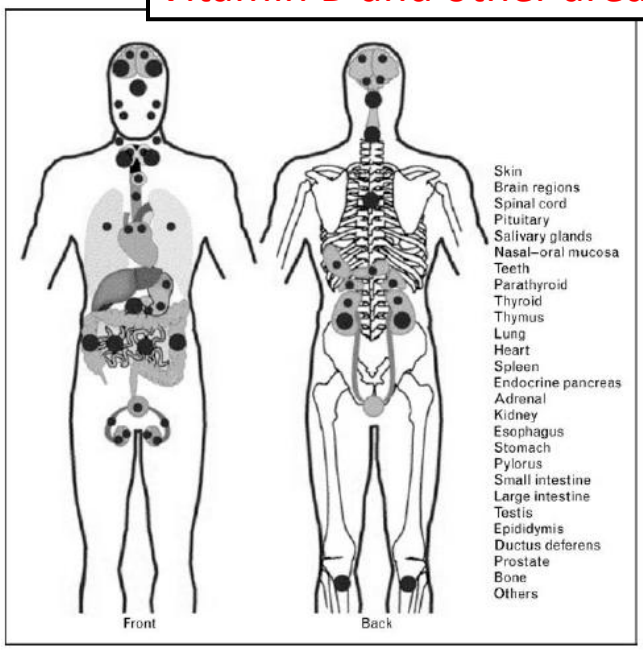

Evatt ML, Delong MR, Khazai N, Rosen A, Triche S, Tangpricha V. Prevalence of vitamin d insufficiency in patients with parkinson disease and alzheimer disease. Arch Neurol 2008 Oct;65(10):1348-52.

# Bone Health is Tip of the Iceberg



- Directly or indirectly vitamin D controls more than 200 genes
- Genes are involved in regulation of cellular:
  - Proliferation
  - Differentiation
  - Apoptosis
  - Angiogenesis

## Vitamin D and other areas of the body




Vitamin D acts diffusely in the body

## Vitamin D in the Brain

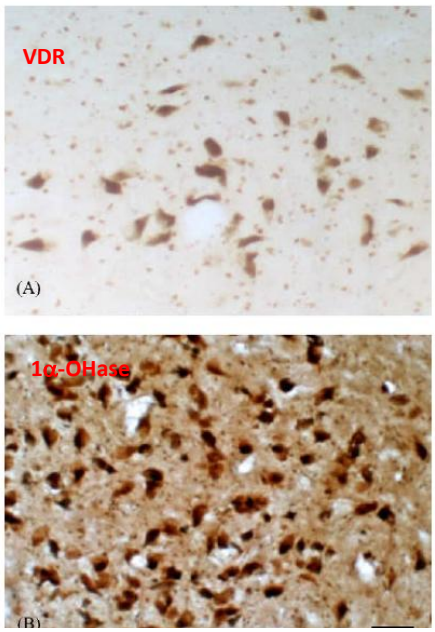
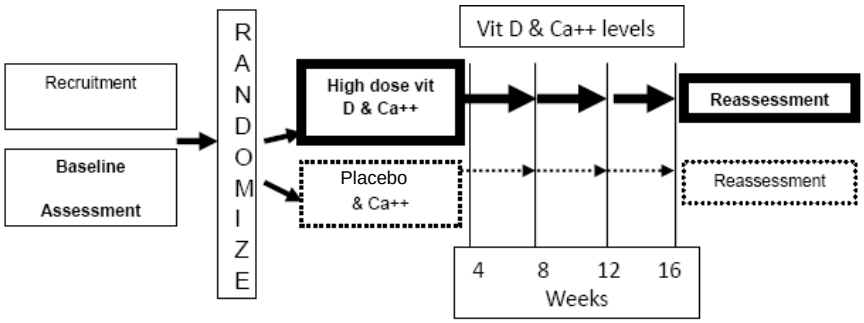



Fig. 6. (A) About one-half the macrocellular neurons within the substantia nigra stain intensely for VDR. (B) A greater percentage of these neurons stain strongly for 1α-OHase. Bar = 50 μm.

Eyles DW, Smith S, Kinobe R, Hewison M, McGrath JJ. Distribution of the vitamin D receptor and 1 alpha-hydroxylase in human brain. J Chem Neuroanat 2005 Jan;29(1):21-30.

# Vitamin D Intervention Study




# Study Design

**Timetable and organizational chart**

| | | | | |
|---|---|---|---|---|
| Prior to study visit | Recruitment | | | |
| Study Visit 1 (110 minutes) | Consent (5 minutes) | **Measures:** (60 minutes) SOT iTUG Biodex Falls review PDQ39 NHP | **Laboratory:** (15 minutes) Vitamin D Ionized $Ca^{++}$ | **Possible Confounder:** (30 minutes) Cognitive tests Parkinson's assessment Medication list Modified Aims |
| Study Visits 2-4 (45 minutes) | Randomization Quality of life (visit 2) | **Measures:** (15 minutes) Falls review Diary Review (Visit 2,3,4) | **Laboratory:** (15 minutes) Vitamin D Ionized $Ca^{++}$ (Visit 2,3,4) | Distribution of Study Drugs (15 minutes) (Visit 2,3,4) |
| After Visits 2-4 | Review of laboratory data | Telephone contact to patient and withdraw from study if elevate vitamin D or $Ca^{++}$ | | |
| Study Visit 5 (105 minutes) | | **Measures:** (60 minutes) SOT iTUG Biodex Falls review PDQ39 NHP | **Laboratory:** (15 minutes) Vitamin D Ionized $Ca^{++}$ | **Possible Confounder:** (30 minutes) Cognitive tests Parkinson's assessment Medication list Modified Aims |

# Work proposed – study population

Inclusion Criteria:

1. Medically confirmed diagnosis of Parkinson's disease
2. Ability to ambulate 50 feet without the assistance of another person.
3. Ability to cooperate with balance testing.
4. Greater than or equal to 50 years of age.
5. Vitamin D level less than 40ng/ml
6. At least 1 fall or 2 near falls in last month or 1+ on pull test

Exclusion Criteria:

1. Significant cognitive deficits as defined by a Mini Mental Status Exam (MMSE) of <25.
2. Another neurological or orthopedic deficit that in the investigator's opinion would have a significant impact on gait and cognition (e.g. stroke, fracture).
3. Hypercalcemia or a history of hypercalcaemia or kidney stones.
4. Current vitamin D supplementation >600IU/day
5. History of untreated tuberculosis

# The End