Disclosure Statement

Dr. Hall

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How Big is the Problem of Falls in Seniors?

- Falls in persons > 65 years is the #1 cause of accidental death
  - **BUT** fewer than half talk to their healthcare provider
- Fallers ≥ 75 years are 4-5 x more likely to enter LTC facility for ≥ 1 year
- Direct medical costs of falls in the US in 2013 were $34 billion!
  - 90% of hip fractures result from fall
  - Expected to rise to $54 billion by 2020

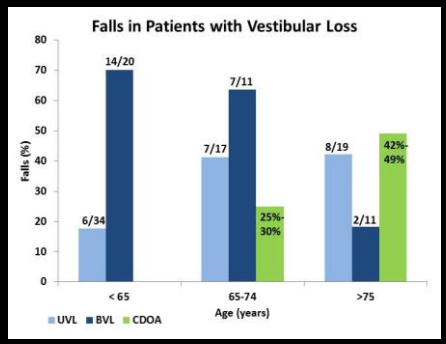
(www.cdc.gov/ncipc)

Fall Risk Factors

- Meta-analysis by Deandrea et al. (2010)
  - 74 studies included
  - 31 risk factors included (≥ 5 studies with comparable protocols)
  - Not included: muscle weakness, balance impairment, vitamin D level, antidepressant/antipsychotic use, multifocal lenses
- Factors that increases the odds of falling 2-3x:
  - History of falls
  - Use of walking aids
  - Fear of falling
  - Parkinson's disease
  - Dizziness or Vertigo
  - Gait problems
  - Cognitive impairment
  - Use of antiepileptic drugs

Dizziness is a Major Risk Factor for Falls

- Adults with vestibular dysfunction more likely to report dizziness and falls (Agrawal, 2009)
  - 8-fold increase in the odds of falling
- Vestibular asymmetry associated with fall-related fractures (Pothula, 2004)
- Limitation: Vestibular loss not confirmed with laboratory tests of vestibular function (based on clinical test of balance or symptoms)



(Herdman et al., 2000)

Know what to ask your older patients

3 Key Questions:

- Have you fallen in the past year?
- Do you feel unsteady when standing or walking?
- Do you worry about falling?

YES to any of these questions indicate increased fall risk and should trigger further evaluation.

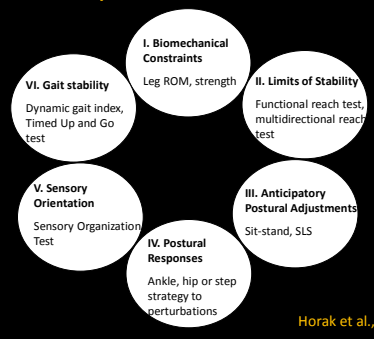
Postural Control

Current concept: Postural control is a complex motor skill resulting from the interaction of multiple sensorimotor processes.

Old concepts: Originally thought to consist of a set of reflexes that triggered equilibrium responses based on visual, vestibular or somatosensory triggers.

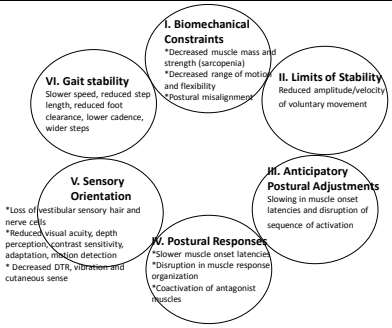
'Balance center' in the central nervous system controlled balance

Model of systems underlying postural control



Horak et al., *PTJ*, 2009

Age-related changes in systems underlying postural control



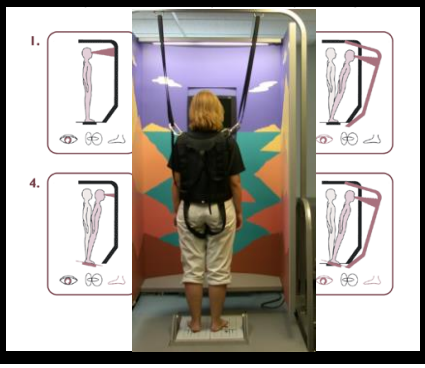
Computerized Dynamic Posturography (CDP) to Assess Multiple Dimensions of Balance

- Sensory Organization Test (SOT)
  - Measure of ability to integrate vision, somatosensory and vestibular inputs to maintain balance
- Motor Control Test (MCT)
  - Assesses postural responses to sudden surface perturbations (translations)
- Adaptation Test
  - Assesses ability to adapt to repeated toes up and toes down perturbations
- Limits of Stability Test (LOS)
  - Assesses ability to voluntarily move center of gravity without changing base of support

CDP vs ENG to identify impaired balance and fall risk

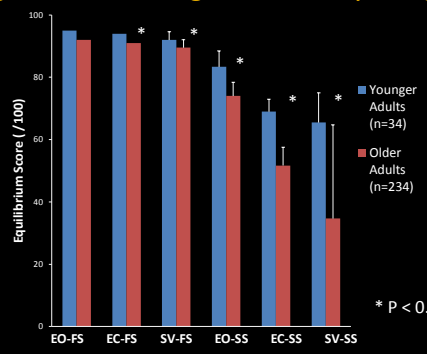
- 103 balance-impaired patients (mean age = 57.5 yr; 59% female) (Keim, 1993)
  - Abnormal test results: SOT-71%; MCT -11%; ENG–42%
- 33 patients with history of falls (mean age = 78.0 yr; 67% female) (Girardi et al., 2001)
  - Abnormal test results: SOT-71%; LOS-71%; ENG-60%
  - LOS associated with recurrent fallers

Sensory Organization Test



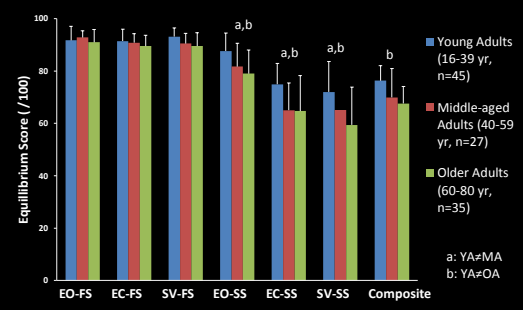
Neurocom®

Age-related changes in sensory integration



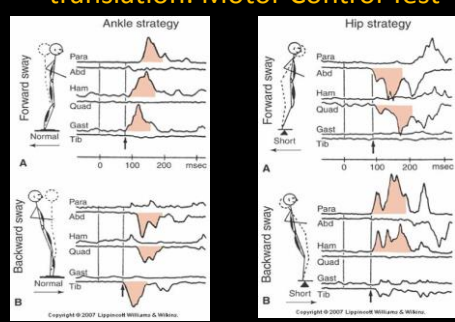
Wolfson et al., 1992

Specific age-related changes in SOT



Liaw et al., 2009

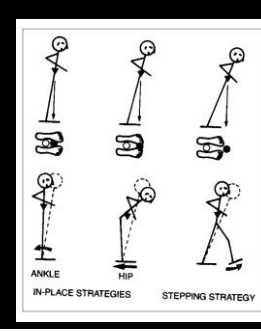
Postural responses to support surface translation: Motor Control Test



Shumway-Cook & Woollacott, 2007

Postural control movement strategies to perturbed balance

- Fixed support strategies
  - Ankle strategy
  - Hip strategy
- Change-in-Support strategies
  - Step strategy
  - Reach or grasp (UE) strategy



Age-related changes to support surface translations

- Postural control tested in 214 subjects, 7 – 81 years (Peterka & Black, 1990)
- Wide range of normal function; however, muscle onset latencies demonstrated a small increase with age
- Older vs younger adults have longer latencies during large perturbations (Wolfson et al., 1992)

Postural responses to support surface rotations: Adaptation Test

- Initial response (70-100 ms) is destabilizing and triggered by proprioceptive input
- Stabilizing response (100-120 ms) triggered by vestibular and visual input (Allum & Honegger, 1992)
- Age-related changes only in 1st or 2nd trial
  - Toes-up loss of balance: Older adults-49%, 16%, 8%, 6%, 5%; Younger adults-3%, 0, 0, 0, 0
  - Toes-down loss of balance: Older adults-28%, 1%, 0, 0, 0; Younger adults-6%, 0, 0, 0, 0

(Wolfson et al., 1992)

Does Fall Prevention Work?

YES!

- Meta-analysis of 44 trials that included an exercise program demonstrated reduced rate of falling by 17% (Sherrington, 2008)
- Greatest effect on fall rates (RR = .58) associated with:
  - Higher total dose of exercise (> 50 hours)
  - Challenging balance exercises
  - Did not include a walking program

Vestibular Rehabilitation for Vestibular Hypofunction in Elderly

- Similar outcomes relative to disability and post-therapy symptoms in patients > 70 years (Shepard et al., 1990; Telian et al., 1996; Whitney et al., 2002)
  - Older adults had more treatment sessions
- Dynamic visual acuity improved with Vestibular Rehabilitation in patients with UVH (Herdman et al., 2003)
  - 8 of 13 were ≥ 65 years

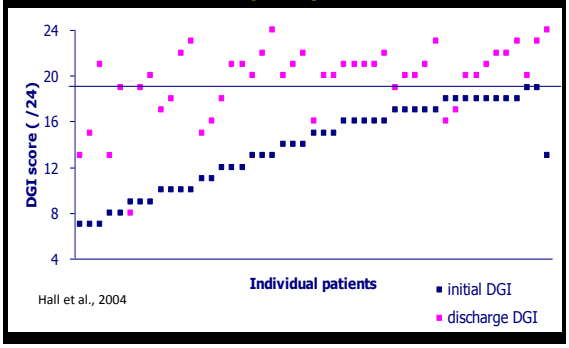
- Baseline difference in Dynamic Gait Index (DGI <20/24 indicates fall risk)
  - YA (33 ± 6 yr) = 15.2, OA (71 ± 7 yr) = 18.4
- No age group differences after Vestibular Rehabilitation except balance confidence
  - Balance Confidence scale: YA = 667%; OA = 80%
  - Dynamic Gait Index: YA = 20.7; OA = 20.6
  - Dizziness Handicap Inventory: YA = 32; OA= 36

Whitney et al., 2002

Vestibular Rehabilitation for Vestibular Hypofunction in Elderly: Fall risk

Older adults with either central or peripheral vestibular dysfunction are more likely to be at risk for falls at discharge (Badke et al., 2004; Hall et al., 2004)

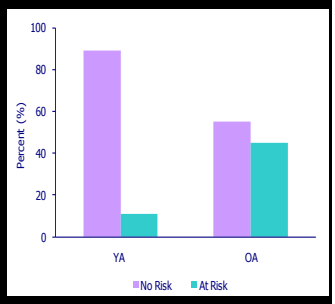
Efficacy of Vestibular Rehabilitation: Fall Risk



Hall et al., 2004

Impact of Age on Fall Risk

- OA and YA improved (p<0.001)
  - OA: 13.3 (3.4) to 19.3 (3.4)
  - YA: 14.5 (4.1) to 20.1 (2.8)
- A greater proportion of older adults (45%) remained at risk for falls at discharge



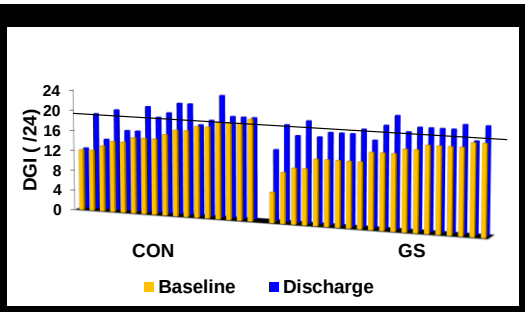
Hall et al., 2004

Vestibular rehabilitation for non-vestibular dizziness?

- Participants:
  - Referred to outpatient physical therapy for dizziness
  - Dizziness = unsteadiness, spinning, a sense of movement or lightheadedness
- Inclusion criteria : ≥ 60 years of age, documented balance or mobility problems, and normal vestibular function
- Exclusion criteria: progressive neurological disorder, cognitive deficit

Findings

- Both groups received standard balance and gait training to improve postural stability
- Randomly assigned to gaze stabilization (GS) or control group (CON)
- **No** baseline differences between groups
- Both groups improved significantly in all outcome measures, except Disequilibrium VAS



Significant interaction for fall risk (p = 0.026)
- Fall risk reduced to a greater extent for GS than CON
- 90% of GS demonstrated a clinically significant improvement in fall risk versus 50% of CON

Take home message

✓ Falls are not a normal age-related phenomenon
- Healthcare providers need to ask directly!

✓Exercise interventions are effective in reducing falls in older adults

✓Vestibular rehabilitation is effective in older adults
- Many will remain at risk for falls
- Assistive device for safe ambulation
- Use of lighting for ambulation

(www.pathlighter.com)

Future directions

- Functional implications of age-related decline in vestibular function in healthy individuals
  - Are interventions effective at ameliorating this decline?
- Within subject study design to examine aging across sensory systems
- Longitudinal study to examine rates of decline across sensory systems