Addressing Balance in Patients with Musculoskeletal dysfunction

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Balance is MIRACULOUS !!!

…..Complex and Interactive

Balance
The ability to maintain the body's center of gravity (COG) over the base of support in a given sensory environment

Dynamic Equilibrium (Balance Stability)
Sensory Organization
Motor Coordination

Sensory weighting is task-dependent in normal individuals

WEIGHTING
Stable Surface
• 70% SOM
• 20% VEST
• 10% VIS

Unstable Surface
• 60% VEST
• 30% VIS
• 10% SOM

Q: What is ‘normal’ – Who is ‘normal’?
Q: What occurs when an individual has a lesion within a given sensory system?

Horak 2006 based on Bodis-Wollner I & Wollner, 1982; 2005 ...

Anterior-posterior Stability

- Ankle strategy
- Hip strategy
- Stepping strategy

Medial-Lateral Stability

- Alternative strategies used to recover stability in mediolateral direction
- Muscle patterns organized in a proximal-to-distal direction

Range of Motion and Postural Control

- Postural alignment
  - Loss of spinal flexibility associated with changes in postural alignment
  - Shift of center of body mass backward towards heels
  - Loss of ankle joint flexibility limits the use of ankle strategy and tibial advancement during ambulation
  - Increased kyphosis associated with impaired balance, slower walking and stair climbing, shorter functional reach, and decreased ADL performance

Abnormal Postural Control

Musculoskeletal Conditions
Chronic Neck Pain

- Decreased postural control compared to normal controls
  
  - Increased AP and ML sway during eyes open and eyes closed conditions
  
  - Older adults with idiopathic neck pain
  - Higher falls efficacy
  - Greater levels of dizziness handicap
  - Higher COP velocities

Saadat et al 2018

Low Back Pain

- Increased postural sway with eyes closed

- Increased in postural sway that increases with cognitive task

- Use an ankle strategy (proprioceptive postural control strategy) even when not the most effective (i.e. standing on unstable surface)

- Postural sway increases with increased pain

- Use a different postural motor strategy to maintain quiet stance

- Possibly due to reweighting of sensory input

- Forward inclined posture

- Possibly in anticipation of postural instability

- Possible factor in recurrence of low back pain

Quek et al 2018

Osteoarthritis

- Muscle weakness

- Pain

- Proprioception degrades

- Steady state and perturbed balance impaired

- Neuromuscular control decreases

- Osteoarthritis and accompanying reduced joint position sense results in increased sway during quiet stance

- People with osteoarthritis have 2.5 times the risk of falling

Brand et al 2015

- People with knee osteoarthritis have higher fall risk

- Vitamin D insufficiency was associated with poorer knee function during balance recovery, greater pain, and locomotor dysfunction

- Physical Therapy Interventions

<table>
<thead>
<tr>
<th>SMD</th>
<th>Strengthening</th>
<th>Tai Chi</th>
<th>Aerobic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Falls Risk</td>
<td>0.44</td>
<td>0.49</td>
<td>0.82</td>
</tr>
</tbody>
</table>

Brandt et al 2019

Knee Osteoarthritis
### Lower Limb Arthroplasty

- **Lower Limb Arthroplasty**
  - Persistent asymmetric load distribution ([Stensdotter et al, 2015](#))
  - Proprioceptive deficits that persist for at least 12 months following TKA ([Stan et al, 2013](#); [Levinger et al, 2012](#))
  - Proprioceptive and strength deficits persist at least 1 year following THA ([Bascuas et al, 2013](#))
  - Sensorimotor function can be improved through dedicated sensorimotor training ([Pohl et al, 2015](#); [Moutzouri et al, 2018](#))
  - Preoperative high intensity strength training is effective for improving postural control before and immediately after TKA ([Casana et al, 2019](#))

### Lower Limb Amputations

- **Lower Limb Amputations**
  - Impaired postural control while sitting and standing ([Hendershot, 2013](#))
  - Increased AP and ML sway
  - Decreased proprioception and/or reductions in reflexive muscle responses could explain the response

### Balance Assessment

- **Balance Assessment**
  - Focus on systems underlying postural control
    - Cardiorespiratory system
    - Cognition
    - Musculoskeletal system
    - Sensory system
    - Orientation in space
    - Movement strategies

### Multifactorial Balance Assessment

- **Multifactorial Balance Assessment**
  - Focused history
    - Relevant medical history
    - Acute or chronic medical problems
    - Family history
    - Risk factors for falls (osteoporosis, urinary incontinence, cardiovascular disease)
    - Medication review: all prescribed and over-the-counter medications with dosages
    - History of falls: detailed circumstances of the fall(s), frequency, symptoms at time of fall, injuries, other consequences
    - Social history
    - Environmental assessment
    - Cognitive Status
    - Montreal Cognitive Assessment

### Medications that Affect Balance

- **Medications that Affect Balance**
  - Benzodiazepines, anti-anxiety and sedative medications
    - Central nervous system depressants, may have significant hypotensive effects
    - Cause decreased awareness of movement and position in space, slowed motor output and central nervous system integration
  - Anti-hypertensives
    - Cause orthostatic hypotension, increased urinary urgency
  - Aminoglycoside antibiotics, long loop diuretics, chemotherapeutic agents
    - Toxic to vestibular hair cells leading to bilateral vestibular dysfunction
### Multifactorial Balance Assessment

- **Physical Examination**
  - Cardiovascular status
    - Heart rate and rhythm
    - Postural pulse and blood pressure – supine, sitting, and standing
    - Pulse Oximetry
  - Integumentary System
    - Feet and footwear
    - Protective sensation (10 g monofilament)
  - Musculoskeletal System
    - Joint range of motion
    - Muscle strength - myotomes

- **Neurological Examination**
  - Sensation: light touch, pinprick, vibration (128 Hz), monofilaments (10 g protective sensation), proprioception
  - Reflexes
  - Cranial nerves including vestibular system
  - Ocular Motor Exam
    - Dix-Hallpike Maneuver
  - Visual acuity and visual contrast sensitivity
  - Gait, balance and mobility levels

### Orthostatic Hypotension

- **Examination**
  - Examine BP in supine, sitting and standing
  - Lying for 5 minutes, sitting and standing at 1 and 3 minutes (within 3 minutes of standing)

- **Interpretation**
  - > 20 mm Hg decline in systolic BP with supine to standing
  - > 10 mm Hg decline in diastolic BP
  - Increase in heart rate > 20 bpm

### Cervical Proprioception

- **Joint Position Error Test**
  - Questionable reliability and validity
    - Quartey et al 2019

- **Subjective Visual Vertical**
  - [http://www.mvrc.pitt.edu/files/svv-bucket-how-to.pdf](http://www.mvrc.pitt.edu/files/svv-bucket-how-to.pdf)

- **Posture Assessment**
  - Look at alignment from all directions
    - Anterior, posterior and lateral
  - Look at COG position
    - COG offset will require modifications of balance strategies
Mobility Assessment

- Range of Motion
  - Cervical Spine
  - Thoracic and Lumbar Spine
  - Upper and Lower Extremities

Intersegmental Mobility

- Cervical, Thoracic, and Lumbar Spine
- Note any restrictions

Subjective Assessment of Balance

- Activities-specific Balance Confidence Scale
  - 16 functional items with varying degrees of difficulty
  - Items rated on scale of 0 (not confident) to 100% (Completely confident) on confidence in performing activity
  - Responses are averaged and a percentage score generated
  - Developed to quantify fear of falling in older adults
  - Lower scores indicate greater fear of falling
  - Scores < 50 indicate home bound older adults
  - Scores 50-79 indicate older adult with chronic health problems or in retirement centers
  - Scores > 80 indicate highly functioning community dwelling older adult
  - Correlates with DHI in persons with vestibular disorders
  - Developed by Myers et al. 1998
  - Scores < 50 indicate home bound older adult
  - Scores 50-79 indicate older adult with chronic health problems or in retirement centers
  - Scores > 80 indicate highly functioning community dwelling older adult
  - Correlates with DHI in persons with vestibular disorders
  - Excellent test-retest reliability (r > .87)

Subjective Assessment of ADLs

- Vestibular Disorders Activities of Daily Living Scale (VADL)
  - Developed to assess self-perceived disability in patients with vestibular impairments
  - Items include 27 activities of daily living
  - Scale rated from 1 (independent) to 10 (ceasing to participate in the activity)
  - Scored as a median so patients can skip an item and the test still has validity

Evaluation of the Use of Sensory Information for Balance

- Clinical Test of Sensory Interaction and Balance
  - Reliable
  - Adults with balance dysfunction Kappa ranged from 0.31 to 0.81
  - Valid
  - Correlates with Sensory Organization Test in people with vestibular dysfunction
  - Inability to maintain stance on foam predicted future multiple falls (OR 4.21)

Clinical Test of Sensory Interaction and Balance

Diane M Wrisley, PT, PhD
Balance in Musculoskeletal Dysfunction

NCPTA Fall Conference 2019
Clinical Test of Sensory Interaction on Balance

<table>
<thead>
<tr>
<th>Condition</th>
<th>Surface</th>
<th>Eyes Open</th>
<th>Sensory Input Available (0)</th>
<th>Abnormal Scores Include:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Firm</td>
<td>Firm</td>
<td>Accurate Vision</td>
<td></td>
<td>Possible motor impairment</td>
</tr>
<tr>
<td></td>
<td>Eyes Closed</td>
<td>Absent Vision</td>
<td>Accurate somatosensory info</td>
<td>Imbalanced use of somatosensory info</td>
</tr>
<tr>
<td>Firm</td>
<td>Visual Conflict Dome</td>
<td>Inaccurate Vision</td>
<td>Accurate somatosensory info</td>
<td>Impaired use of somatosensory info</td>
</tr>
<tr>
<td></td>
<td>Eyes Open</td>
<td>Accurate Vision</td>
<td>Inaccurate somatosensory info</td>
<td>Impaired use of visual info</td>
</tr>
<tr>
<td></td>
<td>Eyes Closed</td>
<td>Absent Vision</td>
<td>Inaccurate somatosensory info</td>
<td>Impaired use of vestibular info</td>
</tr>
<tr>
<td>Visual Conflict Dome</td>
<td>Inaccurate Vision</td>
<td>Inaccurate somatosensory info</td>
<td>Impaired use of vestibular info</td>
<td></td>
</tr>
</tbody>
</table>

30 Second Chair Stand Test (Jones et al 1999)

- Administered using a folding chair without arms, placed against a wall
- Measure number of times a person can come to complete standing in 30 seconds without using arms
- Excellent test-retest reliability r=0.89

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>60-64</td>
<td>&gt;12</td>
<td>16-39</td>
<td>&gt;12</td>
<td>12-37</td>
</tr>
<tr>
<td>65-74</td>
<td>&gt;12</td>
<td>16-39</td>
<td>&gt;12</td>
<td>12-37</td>
</tr>
<tr>
<td>75-84</td>
<td>&gt;12</td>
<td>16-39</td>
<td>&gt;12</td>
<td>12-37</td>
</tr>
</tbody>
</table>

Four Square Step Test (Dite and Temple 2002)

- Measure the amount of time it takes to walk around the squares clockwise then counterclockwise
- Scores of > 12 seconds indicate increased risk of falls in people with vestibular dysfunction
- Excellent test-retest reliability
- Concurrent validity established

Functional Reach/Multidirectional Reach

<table>
<thead>
<tr>
<th>Direction</th>
<th>Above average (inches)</th>
<th>Below average (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forward</td>
<td>12.2</td>
<td>&lt;5.6</td>
</tr>
<tr>
<td>Backward</td>
<td>&gt;7.6</td>
<td>&lt;1.6</td>
</tr>
<tr>
<td>Right lateral</td>
<td>9.4</td>
<td>&lt;3.8</td>
</tr>
<tr>
<td>Left lateral</td>
<td>9.4</td>
<td>&lt;3.8</td>
</tr>
</tbody>
</table>

Evaluation of Gait and Balance

- Multiple item balance tests
  - 14 items graded on an ordinal scale 0-4
  - Reliability ICC = 0.85 in older adults
  - Scores below 45 indicate increased risk of falling in community dwelling older adults (Summary of Berg et al 1992)
  - Scores of < 36 indicate a 100% chance of falling in the next 6 months (Summary Cook et al 2007)
  - Ceiling effect in community dwelling older adults

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Balance in Musculoskeletal Dysfunction
NCPTA Fall Conference 2019
Mini-BESTest (Franchignoni et al. 2010)

- 14 items based on original BESTest (Horak et al. 2009)
- Scored on ordinal scale of 0-2
- Excellent test-retest reliability
- Excellent correlation with BESTest and Global Rating of Change
- Normative scores not established
- Scores of < 20/28 indicate increased risk of falling in people with Parkinson Disorder


Mini-BEST Psychometrics

- Scores ≤ 17.5 indicate increased risk of falling in people post stroke
- MDC 3.5; MCID 4 using various populations (Godi et al. 2013)
- MDC 5.52 in people with Parkinson Disease (King et al. 2012)

Evaluation of Gait and Balance

- Gait Tests
  - Timed "Up & Go" (TUG) (Podsiadlo and Richardson 1991)
    - A person is timed while they stand from a sitting position, walk 3 meters (at self-selected speed), turn, walk back to the chair and sit down
    - Reliable: ICC r=0.95 in community dwelling older adults
    - Scores of > 11 seconds correctly classify older adults who will fall (Podsiadlo and Richardson 1991, Trueblood et al. 2001, Wrisley and Kumar 2010)
  - Functional Gait Assessment (Wrisley et al. 2004)
    - 10 item test graded on an ordinal scale (0-3)
    - Reliability: ICC = 0.93 in healthy adults
    - Scores of ≤ 22/30 correctly classify older adults who will fall (Wrisley and Kumar 2010)
      - LR+: 3.6
      - LR-: 0.00
    - Scores of < 15/30 identified people with Parkinson Disease who had a history of falling
      - MCID: 8 points for people with vestibular disorders (Marchetti et al.)

Table 1.
Functional Gait Assessment Total Scores by Decade

<table>
<thead>
<tr>
<th>Age (y)</th>
<th>N</th>
<th>Minimum Score</th>
<th>Maximum Score</th>
<th>Mean</th>
<th>SD</th>
<th>95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>60–69</td>
<td>27</td>
<td>24</td>
<td>50</td>
<td>28.9</td>
<td>1.5</td>
<td>28.3-29.5</td>
</tr>
<tr>
<td>70–79</td>
<td>55</td>
<td>25</td>
<td>50</td>
<td>28.4</td>
<td>1.0</td>
<td>27.9-29.0</td>
</tr>
<tr>
<td>60–69</td>
<td>65</td>
<td>20</td>
<td>50</td>
<td>27.1</td>
<td>2.5</td>
<td>26.5-27.7</td>
</tr>
<tr>
<td>70–79</td>
<td>44</td>
<td>16</td>
<td>50</td>
<td>24.9</td>
<td>3.0</td>
<td>23.9-26.0</td>
</tr>
<tr>
<td>60–69</td>
<td>55</td>
<td>10</td>
<td>28</td>
<td>20.8</td>
<td>4.7</td>
<td>19.2-22.6</td>
</tr>
<tr>
<td>Total</td>
<td>200</td>
<td>10</td>
<td>50</td>
<td>26.4</td>
<td>4.0</td>
<td>25.5-25.6</td>
</tr>
</tbody>
</table>

Walker et al. 2007

Mini-Balance Evaluation Systems Test (mini-BESTest)

1. Anticipatory Postural Adjustments
   1. Sit to Stand
   2. Rise to Toes
   3. Stand on One Leg
2. Reactive Postural Responses
   4. Compensatory Stepping Correction – Forward
   5. Compensatory Stepping Correction – Backward
   6. Compensatory Stepping Correction – Lateral
3. Sensory Orientation
   7. Stance feet together – eyes open, firm surface
   8. Stance feet together – eyes closed, firm surface
   9. Stance Turn Up – Eyes Closed
4. Stability in Gait
   11. Walk with Head Turns – Horizontal
   11. Walk with Pivot Turns
   14. Step over obstacle
   17. Timed "Sit Up & Go" with Dual Task
6-minute Walk Test

- Calculate the total distance walked in 6 minutes
- Need a long corridor – recommended 30 m
- Allowed rests as needed
- Monitor HR, Borg scale, Pulse oximetry as needed

Higher Level Balance Assessment

- Star Balance Test
- Balance Error Scoring System (BESS)
- High Level Mobility Assessment Tool (HIMAT)
- Community Balance and Mobility Scale

Balance Error Scoring System

High Level Mobility Assessment Tool

- Walking: forwards, backwards, on toes, over obstacle, stairs
- Running
- Skipping
- Hopping

Community Balance and Mobility Scale

- Unilateral Stance
- Tandem Walking
- 180 Tandem Pivot
- Hopping Forward
- Crouch and Walk
- Walking and Looking
- Running
- Stairs

http://www.midss.org/sites/default/files/community20balance20and20mobility20scale20revised20guidelines20june202011.pdf
Balance Intervention

Musculoskeletal Intervention

- Treat musculoskeletal deficits
  - ROM
  - Strength
  - Posture
  - Interssegmental mobility
  - Pain
  - Soft tissue dysfunction

- Treat balance deficits
  - Limits of stability
  - Balance strategies
  - Use of sensory information

Use of Sensory Information: Somatosensory

- Promote use of somatosensory inputs
  - Disadvantage vision while providing reliable somatosensory input (stable surface)
  - Examples of activities:
    - Standing sway exercise with eyes closed, in dimmed light or darkness
    - Sit to and from stand with eyes closed
    - Ambulation with head and eye movements
    - Conflicting visual environments: crowds, striped curtains, moving visual surroundings.
    - Rice exercise

Use of Sensory Information: Visual

- Promote use of visual inputs:
  - Disadvantage somatosensory input while providing reliable visual cues (stable visual field with landmarks)
  - Examples of activities:
    - Standing/sitting on rocker board, BAPS board, moving platforms
    - Standing/ sitting on compliant surface/foam
    - Ambulate with foam boots
    - Instruct in visual fixation

Use of Sensory Information: Vestibular

- Promote use of vestibular inputs:
  - Disadvantage vision and somatosensation while providing reliable vestibular cues (detectable head position)
  - Examples of activities:
    - Practice standing or ambulating on unstable or compliant surface with:
      - Absent vision (eyes closed)
      - Destabilized vision (head and eye movements)
      - Confused vision (visual conflicting environment)

Vestibular

- Examples of activities (continued)
  - Difficulty can be increased by adding neck extension and rotation to place vestibular organs at disadvantage.
  - Vestibular stimulation exercises may also stimulate use of vestibular inputs.
References


17. Franchignoni F, Horak F, Godi M, Nardone A, Giordano A. Using psychometric


50. Powell LE, Myers AM. The Activities-specific Balance Confidence (ABC) Scale. *J...*
The Activities-specific Balance Confidence (ABC) Scale

Administration
The ABC can be self-administered or administered via personal or telephone interview. Larger typeset should be used for self-administration, while an enlarged version of the rating scale on an index card will facilitate in-person interviews. Regardless of method of administration, each respondent should be queried concerning their understanding of instructions, and probed regarding difficulty answering specific items.

Instructions to Participants
For each of the following, please indicate your level of confidence in doing the activity without losing your balance or becoming unsteady by choosing one of the percentage points on the scale from 0% to 100%. If you do not currently do the activity in question, try and imagine how confident you would be if you had to do the activity. If you normally use a walking aid to do the activity or hold onto someone, rate your confidence as if you were using these supports. If you have any questions about answering any of these items, please ask the administrator.

Instructions for Scoring
The ABC is an 11 point scale and ratings should consist of whole numbers (0 to 100) for each item. Total the ratings (possible range 0 to 1600) and divide by 16 to get each subject’s ABC score. If a subject qualifies his/her response to items #2, #9, #11, #14 or #15 (different ratings for “up” vs “down” or “onto” vs “off”), solicit separate ratings and use the lowest confidence of the two (as this will limit the entire activity, for instance likelihood of using the stairs).

# The Activities-specific Balance Confidence (ABC) Scale

For each of the following activities, please indicate your level of self-confidence by choosing a corresponding number from the following rating scale:

<table>
<thead>
<tr>
<th>How confident are you that you will <strong>not</strong> lose your balance or become unsteady when you…</th>
<th>0</th>
<th>10</th>
<th>20</th>
<th>30</th>
<th>40</th>
<th>50</th>
<th>60</th>
<th>70</th>
<th>80</th>
<th>90</th>
<th>100</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. …walk around the house?</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>2. …walk up or down the stairs?</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>3. …bend over and pick up a slipper from the front of a closet floor?</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>4. …reach for a small can off a shelf at eye level?</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>5. …stand on your tip toes and reach for something above your head?</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>6. …stand on a chair and reach for something?</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>7. …sweep the floor?</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>8. …walk outside the house to a car parked in the driveway?</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>9. …get into and out of a car?</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>10. …walk across a parking lot to the mall?</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>11. …walk up or down a ramp?</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>12. …walk in a crowded mall where people rapidly walk past you?</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>13. …are bumped into by people as you walk through the mall?</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>14. …step onto or off of an escalator while you are holding onto a railing?</td>
<td>O</td>
<td>O</td>
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<tr>
<td>15. …step onto or off an escalator while holding onto parcels such that you cannot hold onto the railing?</td>
<td>O</td>
<td>O</td>
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<tr>
<td>16. …walk outside on icy sidewalks?</td>
<td>O</td>
<td>O</td>
<td>O</td>
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</tbody>
</table>
### Instructions

This scale evaluates the effects of vertigo and balance disorders on independence in routine activities of daily living. Please rate your performance on each item. If your performance varies due to intermittent dizziness or balance problems please use the greatest level of disability. For each task indicate the level which most accurately describes how you perform the task. If you never do a particular task, please check the box in the column NA. The rating scales are explained on bottom of page.

### Independence Rating Scale

This scale will help us to determine how inner ear problems affect your ability to perform each task. Please indicate your current performance on each task, as compared to your performance before developing an inner ear problem, by checking one of the columns in the center of the page. Pick the answer that most accurately describes how you perform the task.

<table>
<thead>
<tr>
<th>Task</th>
<th>1</th>
<th>2</th>
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<th>4</th>
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<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>NA</th>
</tr>
</thead>
<tbody>
<tr>
<td>F-1 Sitting up from lying down</td>
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<tr>
<td>F-2 Standing up from sitting on the bed or chair</td>
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<tr>
<td>F-3 Dressing the upper body (e.g., shirt, brassiere, undershirt)</td>
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<tr>
<td>F-4 Dressing the lower body (e.g., pants, skirt, underpants)</td>
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<tr>
<td>F-5 Putting on socks/stockings</td>
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<tr>
<td>F-6 Putting on shoes</td>
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<tr>
<td>F-7 Moving in/out of the bathtub or shower</td>
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<tr>
<td>F-8 Bathing yourself in the bathtub or shower</td>
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<tr>
<td>F-9 Reaching overhead (e.g., to a cupboard or shelf)</td>
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<tr>
<td>F-10 Reaching down (e.g., to the floor or a shelf)</td>
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<tr>
<td>F-11 Meal preparation</td>
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<td>F-12 Intimate activity (e.g., foreplay, sexual activity)</td>
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<td>A-13 Walking on level surfaces</td>
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<td>A-14 Walking on uneven surfaces</td>
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<td>A-15 Going up steps</td>
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<td>A-16 Going down steps</td>
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<tr>
<td>A-17 Walking in narrow spaces (e.g., corridor, grocery store aisle)</td>
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<td>A-18 Walking in open spaces</td>
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<td>A-19 Walking in crowds</td>
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<tr>
<td>A-20 Using an elevator</td>
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<tr>
<td>A-21 Using an escalator</td>
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<td>A-22 Driving a car</td>
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<td>A-23 Carrying things while walking (e.g., package, garbage bag)</td>
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<tr>
<td>A-24 Light household chores (e.g., dusting, putting items away)</td>
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<tr>
<td>A-25 Heavy household chores (e.g., vacuuming, moving furniture)</td>
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<tr>
<td>A-26 Active recreation (e.g., sports, gardening)</td>
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<tr>
<td>I-27 Occupational role (e.g., job, child care, homemaking, student)</td>
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<tr>
<td>I-28 Traveling around the community (car, bus)</td>
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</tbody>
</table>

### Explanation of Independence Rating Scale

This scale will help us to determine how inner ear problems affect your ability to perform each task. Please indicate your current performance on each task, as compared to your performance before developing an inner ear problem, by checking one of the columns in the center of the page. Pick the answer that most accurately describes how you perform the task.

1. **Am not disabled**, perceive no change in performance from before developing an inner ear impairment
2. **Am uncomfortable** performing the activity but **perceive no difference** in the quality of my performance
3. **Perceive a decrement** in the quality of my performance, **but have not changed** the manner of my performance
4. **Have changed** the manner of my performance, e.g., I do things more slowly or carefully than before, or I do things without bending
5. **Prefer using an ordinary object** in the environment for assistance (e.g., stair railing) but I am not dependent on the object or device to do the activity
6. **Must use** an ordinary object in the environment for assistance, but I have not acquired a device specifically designed for the particular activity
7. **Must use adaptive equipment** designed for the particular activity (e.g., grab bars, cane, reachers, bus with lift, reachers, wedge pillow)
8. **Require another person for physical assistance** or, for an activity involving two people, I need unusual physical assistance
9. **Am dependent** on another person to perform the activity
10. **No longer perform** the activity due to vertigo or a balance problem
**NA** Not an activity that I usually perform or I prefer not to answer this question


Diane M Wrisley, PT, PhD
Balance in Musculoskeletal Dysfunction
<table>
<thead>
<tr>
<th>Cranial Nerve</th>
<th>Origin</th>
<th>Exits</th>
<th>Nucleus</th>
<th>Function</th>
<th>Examination</th>
<th>Lesion</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Olfactory</td>
<td>Offactory mucosa of the upper portion of the nasal cavity</td>
<td>Cribiform plate</td>
<td>Processes transverse the cribiform plate and synapse in the olfactory bulb, which through the lateral olfactory stria project directly to the primary olfactory cortex (piriform cortex, parts of the amygdala, and part of the entorhinal cortex), located on the anterior portion of the parahippocampal gyrus; only sense that reaches the cortex directly (not via the thalamus). The intermediate olfactory stria sends fibers via part of the anterior commissure to the contralateral olfactory bulb</td>
<td>Odorants applied to each nostril with eyes closed</td>
<td>Anosmia</td>
<td></td>
</tr>
<tr>
<td>II. Optic</td>
<td>Ganglion cells of the retina</td>
<td>Optic canal</td>
<td>Fibers partially cross in the optic chiasm, proceed in the optic tract, and end in the lateral geniculate body. From the lateral geniculate nucleus the fibers reach the primary visual cortex (cuneus and lingual gyrus via the optic radiation)</td>
<td>Visual acuity, visual field mapping, visual reflexes</td>
<td>Anopsia</td>
<td></td>
</tr>
<tr>
<td>III. Oculomotor</td>
<td>Midbrain at superior colliculus, anterior periaqueductal gray</td>
<td>Interpeduncular fossa</td>
<td>Oculomotor n. [motor]</td>
<td>Extraocular movements (superior, medial, inferior rectus, inferior oblique, and levator palpabrae superioris)</td>
<td>Diplopia, lateral strabismus, posis</td>
<td></td>
</tr>
<tr>
<td>Motor</td>
<td></td>
<td></td>
<td>Edinger-Westphal n. [parasympathetic]</td>
<td>Pupillary constriction in response to light (sphincter pupillae) and during accommodation for near vision (ciliatres)</td>
<td>Mydriasis, Cycloplegia</td>
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<tr>
<td>Parasympathetic</td>
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<tr>
<td>IV. Trochlear</td>
<td>Midbrain at inferior colliculus, anterior periaqueductal gray</td>
<td>Crosses in the superior medullary velum and exits below inferior colliculi</td>
<td>Trochlear n.</td>
<td>Extraocular movements (superior oblique muscle)</td>
<td>Diplopia of down and in eye movements</td>
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<tr>
<td>Motor</td>
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<tr>
<td>V. Trigeminal</td>
<td>Midpons to C3</td>
<td>Peripheral branches:</td>
<td>Nucleus of spinal tract of trigeminal [P &amp; T Long nucleus</td>
<td>Pain &amp; tend from face</td>
<td>Trigeminal neuralgia (tic douloureux)</td>
<td></td>
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<tr>
<td>P &amp; T</td>
<td></td>
<td>• V1 ophthalmic (sensory) exits via the superior orbital fissure</td>
<td></td>
<td>Pain by pinprick, temperature</td>
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</tr>
<tr>
<td>Touch</td>
<td></td>
<td>• V2 maxillary (sensory) exits via the foramen rotundum and ultimately the inferior orbital fissure</td>
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<tr>
<td>Proprioception</td>
<td></td>
<td>• V3 mandibular (mixed) exits via the foramen ovale</td>
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<tr>
<td>Motor</td>
<td>Midpons</td>
<td>Chief sensory n. [touch]</td>
<td>Sensory to the face, scalp, teeth, most of the tongue, oral and nasal mucosa, the dura mater and the cerebral blood vessels</td>
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<td>Facial anesthesia or numbness</td>
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<td></td>
<td>Midpons to midbrain</td>
<td>Mesencephalic n. [proprioception]</td>
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<td></td>
<td>Midpons</td>
<td>Motor n. [muscles of mastication]</td>
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<tr>
<td>VI. Abducens</td>
<td>Lower pons at facial colliculus</td>
<td>Between bulbar pons and pyramid</td>
<td>Abducens n.</td>
<td>Extraocular movements (lateral rectus muscle)</td>
<td>Diplopia, medial strabismus, May injure VI &amp; VII</td>
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<tr>
<td>Motor</td>
<td></td>
<td>Superior orbital fissure</td>
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<tr>
<td>VII. Facial</td>
<td>Lower pons at facial colliculus</td>
<td>Cerebellopontine angle</td>
<td>Facial n. [motor]</td>
<td>Muscles of facial expression, the auricular muscles, the stapedius, the posterior belly of the digastic and the stylohyoid muscles</td>
<td>Facial expression movements</td>
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<tr>
<td>Taste</td>
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<tr>
<td>Parasympathetic</td>
<td>Upper medulla</td>
<td>Solitary n. [taste and parasympathetic]</td>
<td>Taste from anterior 2/3 tongue via the chorda tympani (the peripheral axons of geniculate ganglion), joins the lingual nerve (V3), parasympathetic to submandibular and sublingual salivary glands by means of the submandibular ganglion, and the lacrimal, and serous and mucous glands of the nose and throat and soft palate by means of the pterygopalatine ganglion</td>
<td>Taste</td>
<td>Bell's Palsy</td>
<td></td>
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<tr>
<td>Cranial Nerve</td>
<td>Origin</td>
<td>Exit</td>
<td>Nuclei</td>
<td>Function</td>
<td>Examination</td>
<td>Lesion</td>
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<tr>
<td>VIII. Vestibulocochlear Sensory</td>
<td>Lateral aspect 4th ventricle</td>
<td>Cerebellopontine angle</td>
<td>Vestibular n.</td>
<td>Balance &amp; equilibrium</td>
<td>Caloric test, Bari's chair test</td>
<td>Vertigo, Nystagmus, Dys equilibrium</td>
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<tr>
<td></td>
<td>Acoustic tubercle w/ VII</td>
<td>Cochlear n.</td>
<td>Hearing</td>
<td></td>
<td>Weber and Rinne tests, audiogram</td>
<td>Loss of hearing, Tinnitus</td>
</tr>
<tr>
<td>IX. Glossopharyngeal Taste Parasympathetic Motor</td>
<td>Medulla</td>
<td>Post-olivary sulcus, Jugular foramen</td>
<td>Nucleus of solitary tract [taste and parasympathetic]</td>
<td></td>
<td>Taste and general sensation of the posterior 1/3 of tongue</td>
<td>Pain or loss of sensation in the nasopharyngeal area</td>
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<td>Motor to stylopharyngeus muscle, parasympathetic supply to parotid gland via otic ganglion, afferent parasympathetic fibers from the carotid sinus/body ([f] sensor)</td>
<td>Gag reflex, W/ X motor</td>
</tr>
<tr>
<td>X. Vagus Parasympathetic Motor Taste Sensory</td>
<td>Vagal Trigone, medulla</td>
<td>Post-olivary sulcus, Jugular foramen</td>
<td>Dorsal motor n. [parasympathetic]</td>
<td>Parasympathetic to esophagus, thorax and abdomen</td>
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<td>Loss of parasympathetics to thorax &amp; abdomen, Reduced gag reflex</td>
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<td></td>
<td>Motor to pharyngeal constrictors, intrinsic laryngeal muscles, palate muscles (except tensor veli palatini), and upper esophagus for phonation and swallowing</td>
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<td>Taste - larynx &amp; epiglottis</td>
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<td>Not tongue – VII &amp; IX</td>
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<td></td>
<td>Nucleus of the spinal tract of trigeminal [sensory]</td>
<td>Sensory to the larynx, the concha of the external ear, and the meninges of the posterior fossa</td>
</tr>
<tr>
<td>XI. Accessory Motor</td>
<td>Medulla and cervical segments</td>
<td>Post-olivary sulcus, Jugular foramen W/ IX &amp; X</td>
<td>Nucleus ambiguous</td>
<td>Cranial accessory: w/ X, motor to pharynx, larynx, and soft palate</td>
<td></td>
<td>Cranial: dysphagia, dysphonia, Spinal: paralysis of ipsilateral trapezius &amp; sternocleidomastoid</td>
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<td>XII. Hypoglossal Motor</td>
<td>Hypoglossal Trigone, medulla</td>
<td>Pre-olivary sulcus, hypoglossal canal</td>
<td>Hypoglossal n.</td>
<td>Motor to muscles of tongue (end in glossus, except palatoglossus)</td>
<td></td>
<td>Lateral tongue paralysis and atrophy</td>
</tr>
</tbody>
</table>

Supranuclear (upper motor neuron) lesions of cranial nerves are rare (except for the facial nerve) because the corticobulbar tract innervates them bilaterally.

Each side controls both sides (bilateral) so lesion will not produce symptoms.
Facial nerve will show unilateral lower paralysis
Cranial nerves that have motor components
Upper Motor Neuron
Spinal nerves = corticospinal tract
Cranial nerves = corticobulbar tract
Clinical Test of Sensory Interaction and Balance
Method: Pt performs each condition for a maximum of 30 seconds. If a patient does not complete the full 30 seconds on the first trial they can have 2 more attempts. The scores of the 3 trials are averaged.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Surface</th>
<th>Vision</th>
<th>Sensory Input Available</th>
<th>Abnormal score indicates</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Firm</td>
<td>Eyes open</td>
<td>Accurate vision</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Accurate somatosensory</td>
<td></td>
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<tr>
<td>2</td>
<td>Firm</td>
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### Berg Balance Scale

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<thead>
<tr>
<th>Score</th>
<th>Task</th>
<th>Grading Criteria</th>
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</thead>
<tbody>
<tr>
<td>1. ________</td>
<td>Sitting to Standing</td>
<td></td>
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</tbody>
</table>
Please stand up. Try not to use your hands for support.  
(4) able to stand, no hands and stabilize independently  
(3) able to stand independently using hands  
(2) able to stand using hands after several tries  
(1) needs minimal assist to stand or to stabilize  
(0) needs moderate or maximal assist to stabilize |
| 2. ________ | Standing Unsupported |  
Stand for 2 minutes without holding.  
(4) able to stand safely 2 min  
(3) able to stand 2 min with supervision  
(2) able to stand unsupported  
(1) needs several tries to stand 30 seconds  
(0) unable to stand 30 seconds unassisted |
| 3. ________ | Sitting Unsupported Feet on Floor |  
Sit with arms folded for 2 minutes.  
(4) able to sit safely and securely 2 minutes  
(3) able to sit 2 minutes under supervision  
(2) able to sit 30 seconds  
(1) able to sit 10 seconds  
(0) unable to sit without support 10 seconds |
| 4. ________ | Standing to Sitting |  
Please sit down.  
(4) able to transfer safely with minor use of hands  
(3) able to transfer safely definite need of hands  
(2) able to transfer with verbal cueing and/or definite need of hands  
(1) needs one person to assist  
(0) needs two people to assist or supervise to be safe |
| 5. ________ | Transfers |  
Please move from chair to chair and back again. One way toward a seat with armrests and one way toward a seat without armrests.  
(4) able to transfer safely with minor use of hands  
(3) able to transfer safely definite need of hands  
(2) able to transfer with verbal cueing and/or definite need of hands  
(1) needs one person to assist  
(0) needs two people to assist or supervise to be safe |
| 6. ________ | Standing Unsupported with Eyes Closed |  
Close your eyes and stand still for 10 seconds.  
(4) able to stand 10 seconds safely  
(3) able to stand 10 seconds with supervision  
(2) able to stand 3 seconds  
(1) unable to keep eyes closed 3 seconds but stays steady  
(0) needs help to keep from falling |
| 7. ________ | Standing Unsupported with Feet Together |  
Place your feet together and stand without holding.  
(4) able to place feet together independently and stand 1 minute safely  
(3) able to place feet together independently and stand for 1 minute with supervision  
(2) able to place feet together independently but unable to hold for 30 seconds  
(1) needs help to attain position but able to stand 15 seconds feet together  
(0) needs help to attain position and unable to hold for 15 seconds |
| 8. ________ | Reaching Forward with Outstretched Arm |  
Lift arm to 90 degrees. Stretch out your fingers and reach forward as far as you can.  
(4) can reach forward confidently > 10 inches  
(3) can reach forward > 5 inches safely  
(2) can reach forward > 2 inches safely  
(1) reaches forward but needs supervision  
(0) needs help to keep from falling |
| 9. ________ | Pick Up Object from the Floor |  
Pick up the shoe/slipper which is placed in front of your feet.  
(4) able to pick up slipper safely and easily  
(3) able to pick up slipper but needs supervision  
(2) unable to pick up but reaches 1-2 inches from slipper & keeps balance independently  
(1) unable to pick up and needs supervision while trying  
(0) unable to try/needs assist to keep from falling |
| 10. ________ | Turning to look behind over left and right shoulders |  
Turn to look behind you over toward your left shoulder. Repeat to the right.  
(4) looks behind from both sides and weight shifts well  
(3) looks behind one side only other side shows less weight shift  
(2) turns sideways only but maintains balance  
(1) needs supervision while turning  
(0) needs assist to keep from falling |
11. Turn 360 degrees
Turn completely around in a full circle. Pause, then turn a full circle in the other direction.
(4) able to turn 360 degrees safely in < 4 seconds each side
(3) able to turn 360 degrees safely one side only < 4 seconds
(2) able to turn 360 degrees safely but slowly
(1) needs close supervision or verbal cueing
(0) needs assistance while turning

Dynamic Weight Shifting while Standing Unsupported

12. Count Number of Times Step Touch Measured Stool
Place each foot alternatively on the stool. Count until each foot has touched the stool four times.
(4) able to stand independently and safely complete 8 steps in ≤ 20 seconds
(3) able to stand independently and complete 8 steps in > 20 seconds
(2) able to complete 4 steps without aid with supervision
(1) able to complete > 2 steps, needs minimal assist
(0) needs assistance to keep from falling/unable to try

13. Stand Unsupported One Foot in Front of the Other Foot
Place one foot as close as possible in front of the other foot.
(4) able to place feet tandem and holds for 30 seconds
(3) able to place one foot ahead and hold 30 seconds
takes small step; independently; holds 30 seconds
(1) needs help to step in place, holds 15 seconds
(0) loses balance while stepping or standing

14. Stand on One Leg
Please stand on one leg as long as you can without holding onto anything (knee does not have to be bent).
(4) able to lift leg independently; able to hold for >10 seconds
(3) able to lift leg independently; or needs assist holds 5-10 seconds
(2) able to lift leg independently; holds ≥ 3 seconds
(1) tries to lift leg, unable to hold 3 seconds; remains standing independently
(0) unable to; tries or needs assist to prevent falling

Total Score: _______________ Percent Probability Risk for Falls: _______________

Percent Probability of Falling based on Berg Balance Score and Fall History.

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<thead>
<tr>
<th>Berg Score</th>
<th>No falls in last 6 months</th>
<th>&gt;1 fall in last 6 months</th>
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<tr>
<td>33</td>
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</table>

Calculated by Diane Wrisley, MS, PT, NCS from equation in: Shumway-Cook et al. Predicting the probability for falls in community dwelling older adults. *Phys Ther* 1997;77:812-819
Directions for the Timed “Up & Go”

The timed “Up & Go” test measures, in seconds, the time taken by an individual to stand up from a standard arm chair (approximate seat height of 43-46 cm, arm height 65 cm), walk a distance of 3 meters (approximately 10 feet), turn, walk back to the chair, and sit down again. The subject wears his/her regular footwear and uses his customary walking aid (none, cane, or walker). No physical assistance is given. They start with their back against the chair, their arms resting on the arm rests, and their walking aid at hand. They are instructed that, on the word “go” they are to get up and walk at a comfortable and safe pace to a line on the floor 3 meters away, turn, return to the chair, and sit down again. The subject walks through the test once before being timed in order to become familiar with the test. Either a wrist-watch with a second hand or a stop-watch can be used to time the performance.

Instructions to the patient: “When I say ‘go” I want you to stand up and walk to the line, turn and then walk back to this chair and sit down again. Walk at your normal pace

You may want to also have the patient walk at a fast pace to see how quickly they can ambulate. In addition, have them turn to the right and the left to see how the patient performs (O’Neill, Gill-Body and Krebs, 1998). In people with peripheral vestibular disorders, the timed “Up & Go” test correlated with the Sensory Organization Test 4 (O’Neill, Gill-Body and Krebs, 1998). The TUG had a sensitivity (81%) and specificity (56%) for a positive fall history in persons with vestibular disorders and the cut-off was maximized at TUG 11.1 seconds.

Speed of gait has been correlated with falls in older adults and many of our older adults walk slowly (Bendall MJ, Bassey EJ, Pearson MB, 1989). In older adults, there is value in having some measure of their speed of gait. The timed “Up & Go” test also provides valuable information to the clinician about the ability to rise out of a chair. Scores of 14 or greater indicate high risk for falling in older adults (Shumway-Cook et al, 2000).

Reference List


(5) Gill-Body KM, Beninato M, Krebs D. Relationship among balance impairments,


(13) Shumway-Cook A, Brauer 5, Woollacott M. Predicting the probability for falls in community-dwelling older adults using the Timed Up & Go Test. *Phys Ther* 2000; 80(9):896-903.


### Functional Gait Assessment

**Score** | **Task** | **Grading Criteria: Mark the highest category that applies (i.e. the highest category in which the subject meets all criteria)**
---|---|---
1. | FGA: ________  
Time: ________ | **1. Gait Level Surface:**  
Walk from here to the wall at your normal speed (time for 20')  
(3) Normal: Walks 20 ft in less than 5.5 seconds, no assistive devices, good speed, no evidence for imbalance, normal gait pattern, deviates no more than 6 in outside of the 12-in walkway.  
(2) Mild impairment: Walks 20 ft in less than 7 seconds but greater than 5.5 seconds, uses assistive device, slower speed, mild gait deviations, or deviates 6–10 in outside of the 12-in walkway width.  
(1) Moderate impairment: Walks 20 ft, slow speed, abnormal gait pattern, evidence for imbalance, or deviates 10–15 in outside of the 12-in walkway.  
(0) Severe impairment: Cannot walk 20 ft without assistance, severe gait deviations or imbalance, deviates greater than 15 in outside of the 12-in walkway width or reaches and touches the wall.

2. | FGA: ________ | **2. Change In Gait Speed**  
Begin walking at your normal pace [5 ft]. When I tell you “go,” walk as fast as you can [5 ft]. When I tell you “slow,” walk as slowly as you can [5 ft].  
(3) Normal: Able to smoothly change walking speed without loss of balance or gait deviation. Shows a significant difference in walking speeds between normal, fast, and slow speeds. Deviates no more than 6 in outside of the 12-in walkway width.  
(2) Mild impairment: Is able to change speed but demonstrates mild gait deviations, deviates 6–10 in outside of the 12-in walkway width, or no gait deviations but unable to achieve a significant change in velocity, or uses an assistive device.  
(1) Moderate impairment: Makes only minor adjustments to walking speed, or accomplishes a change in speed with significant gait deviations, deviates 10–15 in outside the 12-in walkway width, or changes speed but loses balance but is able to recover and continue walking.  
(0) Severe impairment: Cannot change speeds, deviates greater than 15 in outside 12-in walkway width, or loses balance and has to reach for wall or be caught.

3. | FGA: ________ | **3. Gait With Horizontal Head Turns**  
Walk from here to the next mark 20 ft away. When I tell you look left, turn your head right and keep walking straight, when I tell you look down, tip your head up and keep walking straight. Have subject turn head every 3 steps.  
(3) Normal: Performs head turns smoothly with no change in gait. Deviates no more than 6 in outside 12-in walkway width.  
(2) Mild impairment: Performs head turns smoothly with slight change in gait velocity (eg, minor disruption to smooth gait path), deviates 6–10 in outside 12-in walkway width, or uses an assistive device.  
(1) Moderate impairment: Performs head turns with moderate change in gait velocity, slows down, deviates 10–15 in outside 12-in walkway width but recovers, can continue to walk.  
(0) Severe impairment: Performs task with severe disruption of gait i.e., staggers 15 in outside 12-in walkway width, loses balance, stops, or reaches for wall.

4. | FGA: ________ | **4. Gait With Vertical Head Turns**  
Walk from here to the next mark 20 ft away. When I tell you look up, tip your head down and keep walking straight, when I tell you look down, tip your head up and keep walking straight. Have subject turn head every 3 steps.  
(3) Normal: Performs head turns with no change in gait. Deviates no more than 6 in outside 12-in walkway width.  
(2) Mild impairment: Performs task with slight change in gait velocity (eg, minor disruption to smooth gait path), deviates 6–10 in outside 12-in walkway width but recovers, can continue to walk.  
(1) Moderate impairment: Performs task with moderate change in gait velocity, slows down, deviates 10–15 in outside 12-in walkway width but recovers, can continue to walk.  
(0) Severe impairment: Performs task with severe disruption of gait (eg, staggers 15 in outside 12-in walkway width, loses balance, stops, or reaches for wall).

5. | FGA: ________ | **5. Gait And Pivot Turn**  
Begin with walking at your normal pace. When I tell you, “turn and stop,” turn as quickly as you can to face the opposite direction and stop.  
(3) Normal: Pivot turns safely within 3 seconds and stops quickly with no loss of balance.  
(2) Mild impairment: Pivot turns safely in >3 seconds and stops with no loss of balance, or pivot turns safely within 3 seconds and stops with mild imbalance, requires small steps to catch balance.  
(1) Moderate impairment: Turns slowly, requires verbal cueing, or requires several small steps to catch balance following turn and stop.  
(0) Severe impairment: Cannot turn safely, requires assistance to turn and stop.

6. | FGA: ________ | **6. Step Over Obstacle**  
Begin walking at your normal speed. When you come to the shoe box, step over it, not around it, and keep walking.  
(3) Normal: Is able to step over 2 stacked shoe boxes taped together (9 in total height) without changing gait speed; no evidence of imbalance.  
(2) Mild impairment: Is able to step over one shoe box (4.5 in total height) without changing gait speed; no evidence of imbalance.  
(1) Moderate impairment: Is able to step over one shoe box (4.5 in total height) but must slow down and adjust steps to clear box safely. May require verbal cueing.  
(0) Severe impairment: Cannot perform without assistance.

7. | FGA: ________  
# steps: ________ | **8. Gait With Narrow Base Of Support**  
Walk on the floor with arms folded across the chest, feet aligned heel to toe in tandem. The number of steps taken in a straight line are counted for a maximum of 10 steps.  
(3) Normal: Is able to ambulate for 10 steps heel to toe with no staggering.  
(2) Mild impairment: Ambulates 7–9 steps.  
(1) Moderate impairment: Ambulates 4–6 steps.  
(0) Severe impairment: Ambulates less than 4 steps heel to toe or cannot perform without assistance.
| 8. | Gait With Eyes Closed | Walk at your normal speed from here to the next mark (20 ft) with your eyes closed. | (3) Normal: Walks 20 ft, no assistive devices, good speed, no evidence of imbalance, normal gait pattern, deviates no more than 6 in outside 12-in walkway width. Ambulates 20 ft in less than 7 seconds.  
(2) Mild impairment: Walks 20 ft, uses assistive device, slower speed, mild gait deviations, deviates 6–10 in outside 12-in walkway width. Ambulates 20 ft in less than 9 seconds but greater than 7 seconds.  
(1) Moderate impairment: Walks 20 ft, slow speed, abnormal gait pattern, evidence for imbalance, deviates 10–15 in outside 12-in walkway width. Requires more than 9 seconds to ambulate 20 ft.  
(0) Severe impairment: Cannot walk 20 ft without assistance, severe gait deviations or imbalance, deviates greater than 15 in outside 12-in walkway width or will not attempt task. |
|---|---|---|---|
| 9. | Ambulating Backwards | Walk backwards until I tell you to stop. | (3) Normal: Walks 20 ft, no assistive devices, good speed, no evidence for imbalance, normal gait pattern, deviates no more than 6 in outside 12-in walkway width.  
(2) Mild impairment—Walks 20 ft, uses assistive device, slower speed, mild gait deviations, deviates 6–10 in outside 12-in walkway width.  
(1) Moderate impairment—Walks 20 ft, slow speed, abnormal gait pattern, evidence for imbalance, deviates 10–15 in outside 12-in walkway width.  
(0) Severe impairment—Cannot walk 20 ft without assistance, severe gait deviations or imbalance, deviates greater than 15 in outside 12-in walkway width or will not attempt task. |
| 10. | Steps | Walk up these stairs as you would at home (ie, using the rail if necessary). At the top turn around and walk down. | (3) Normal: Alternating feet, no rail.  
(2) Mild impairment: Alternating feet, must use rail.  
(1) Moderate impairment: Two feet to a stair; must use rail.  
(0) Severe impairment: Cannot do safely. |

**DGI Total Score (Items 1-7 & 11):** 
**FGA Total Score (Items 1-6, 8-11):** 
Scores of ≤ 19/24 indicates increased risk of falling

ANTICIPATORY  SUB SCORE:  / 6

1. SIT TO STAND
Instruction: “Cross your arms across your chest. Try not to use your hands unless you must. Do not let your legs lean against the back of the chair when you stand. Please stand up now.”
(2) Normal: Comes to stand without use of hands and stabilizes independently.
(1) Moderate: Comes to stand WITH use of hands on first attempt.
(0) Severe: Unable to stand up from chair without assistance, OR needs several attempts with use of hands.

2. RISE TO TOES
Instruction: “Place your feet shoulder width apart. Place your hands on your hips. Try to rise as high as you can onto your toes. I will count out loud to 3 seconds. Try to hold this pose for at least 3 seconds. Look straight ahead. Rise now.”
(2) Normal: Stable for 3 s with maximum height.
(1) Moderate: Heels up, but not full range (smaller than when holding hands), OR noticeable instability for 3 s.
(0) Severe: < 3 s.

3. STAND ON ONE LEG
Instruction: “Look straight ahead. Keep your hands on your hips. Lift your leg off of the ground behind you without touching or resting your raised leg upon your other standing leg. Stay standing on one leg as long as you can. Look straight ahead. Lift now.”
Left: Time in Seconds Trial 1:_____ Trial 2:_____ Right: Time in Seconds Trial 1:_____ Trial 2:_____ 
(2) Normal: 20 s.
(1) Moderate: < 20 s.
(0) Severe: Unable.
To score each side separately use the trial with the longest time.
To calculate the sub-score and total score use the side [left or right] with the lowest numerical score [i.e. the worse side].

4. COMPENSATORY STEPPING CORRECTION- FORWARD
Instruction: “Stand with your feet shoulder width apart, arms at your sides. Lean forward against my hands beyond your forward limits. When I let go, do whatever is necessary, including taking a step, to avoid a fall.”
(2) Normal: Recovers independently with a single, large step (second realignment step is allowed).
(1) Moderate: More than one step used to recover equilibrium.
(0) Severe: No step, OR would fall if not caught, OR falls spontaneously.

5. COMPENSATORY STEPPING CORRECTION- BACKWARD
Instruction: “Stand with your feet shoulder width apart, arms at your sides. Lean backward against my hands beyond your backward limits. When I let go, do whatever is necessary, including taking a step, to avoid a fall.”
(2) Normal: Recovers independently with a single, large step.
(1) Moderate: More than one step used to recover equilibrium.
(0) Severe: No step, OR would fall if not caught, OR falls spontaneously.

6. COMPENSATORY STEPPING CORRECTION- LATERAL
Instruction: “Stand with your feet together, arms down at your sides. Lean into my hand beyond your sideways limit. When I let go, do whatever is necessary, including taking a step, to avoid a fall.”
Left Right
(2) Normal: Recovers independently with 1 step (crossover or lateral OK).
(1) Moderate: Several steps to recover equilibrium.
(0) Severe: Falls, or cannot step.
(2) Normal: Recovers independently with 1 step (crossover or lateral OK).
(1) Moderate: Several steps to recover equilibrium.
(0) Severe: Falls, or cannot step.
Use the side with the lowest score to calculate sub-score and total score.

SENSORY ORIENTATION  SUB SCORE:  / 6

7. STANCE (FEET TOGETHER); EYES OPEN, FIRM SURFACE
Instruction: “Place your hands on your hips. Place your feet together until almost touching. Look straight ahead. Be as stable and still as possible, until I say stop.”
Time in seconds:________
(2) Normal: 30 s.
(1) Moderate: < 30 s.
(0) Severe: Unable.
8. STANCE (FEET TOGETHER); EYES CLOSED, FOAM SURFACE

**Instruction:** “Step onto the foam. Place your hands on your hips. Place your feet together until almost touching. Be as stable and still as possible, until I say stop. I will start timing when you close your eyes.”

- **Time in seconds:**________
  - (2) Normal: 30 s.
  - (1) Moderate: < 30 s.
  - (0) Severe: Unable.

9. INCLINE- EYES CLOSED

**Instruction:** “Step onto the incline ramp. Please stand on the incline ramp with your toes toward the top. Place your feet shoulder width apart and have your arms down at your sides. I will start timing when you close your eyes.”

- **Time in seconds:**________
  - (2) Normal: Stands independently 30 s and aligns with gravity.
  - (1) Moderate: Stands independently <30 s OR aligns with surface.
  - (0) Severe: Unable.

**DYNAMIC GAIT**

10. CHANGE IN GAIT SPEED

**Instruction:** “Begin walking at your normal speed, when I tell you ‘fast’, walk as fast as you can. When I say ‘slow’, walk very slowly.”

- (2) Normal: Significantly changes walking speed without imbalance.
- (1) Moderate: Unable to change walking speed or signs of imbalance.
- (0) Severe: Unable to achieve significant change in walking speed AND signs of imbalance.

11. WALK WITH HEAD TURNS – HORIZONTAL

**Instruction:** “Begin walking at your normal speed, when I say “right”, turn your head and look to the right. When I say “left” turn your head and look to the left. Try to keep yourself walking in a straight line.”

- (2) Normal: performs head turns with no change in gait speed and good balance.
- (1) Moderate: performs head turns with reduction in gait speed.
- (0) Severe: performs head turns with imbalance.

12. WALK WITH PIVOT TURNS

**Instruction:** “Begin walking at your normal speed. When I tell you to ‘turn and stop’, turn as quickly as you can, face the opposite direction, and stop. After the turn, your feet should be close together.”

- (2) Normal: Turns with feet close FAST (≤ 3 steps) with good balance.
- (1) Moderate: Turns with feet close SLOW (>4 steps) with good balance.
- (0) Severe: Cannot turn with feet close at any speed without imbalance.

13. STEP OVER OBSTACLES

**Instruction:** “Begin walking at your normal speed. When you get to the box, step over it, not around it and keep walking.”

- (2) Normal: Able to step over box with minimal change of gait speed and with good balance.
- (1) Moderate: Steps over box but touches box OR displays cautious behavior by slowing gait.
- (0) Severe: Unable to step over box OR steps around box.

14. TIMED UP & GO WITH DUAL TASK [3 METER WALK]

**Instruction TUG:** “When I say ‘Go’, stand up from chair, walk at your normal speed across the tape on the floor, turn around, and come back to sit in the chair.”

**Instruction TUG with Dual Task:** “Count backwards by threes starting at ___. When I say ‘Go’, stand up from chair, walk at your normal speed across the tape on the floor, turn around, and come back to sit in the chair. Continue counting backwards the entire time.”

- **TUG:**________ seconds; Dual Task **TUG:**________ seconds
  - (2) Normal: No noticeable change in sitting, standing or walking while backward counting when compared to TUG without Dual Task.
  - (1) Moderate: Dual Task affects either counting OR walking (>10%) when compared to the TUG without Dual Task.
  - (0) Severe: Stops counting while walking OR stops walking while counting.

When scoring item 14, if subject’s gait speed slows more than 10% between the TUG without and with a Dual Task the score should be decreased by a point.

**TOTAL SCORE:**_____ / 28
**Mini-BESTest Instructions**

**Subject Conditions:** Subject should be tested with flat-heeled shoes OR shoes and socks off.

**Equipment:** Temper® foam (also called T-foam™ 4 inches thick, medium density T41 firmness rating), chair without arm rests or wheels, incline ramp, stopwatch, a box (9” height) and a 3 meter distance measured out and marked on the floor with tape [from chair].

**Scoring:** The test has a maximum score of 28 points from 14 items that are each scored from 0-2. “0” indicates the lowest level of function and “2” the highest level of function.

If a subject must use an assistive device for an item, score that item one category lower.

If a subject requires physical assistance to perform an item, score “0” for that item.

For **Item 3** (stand on one leg) and **Item 6** (compensatory stepping-lateral) only include the score for one side (the worse score).

For **Item 3** (stand on one leg) select the best time of the 2 trials [from a given side] for the score.

For **Item 14** (timed up & go with dual task) if a person’s gait slows greater than 10% between the TUG without and with a dual task then the score should be decreased by a point.

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
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<tbody>
<tr>
<td>1.</td>
<td><strong>SIT TO STAND</strong> Note the initiation of the movement, and use of the subject’s hands on the seat of the chair, the thighs, or the thrusting of the arms forward.</td>
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<tr>
<td>2.</td>
<td><strong>RISE TO TOES</strong> Allow the subject two attempts. Score the best attempt. (If you suspect that subject is using less than full height, ask the subject to rise up while holding the examiners’ hands.) Make sure the subject looks at a non-moving target 4-12 feet away.</td>
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<tr>
<td>3.</td>
<td><strong>STAND ON ONE LEG</strong> Allow the subject two attempts and record the times. Record the number of seconds the subject can hold up to a maximum of 20 seconds. Stop timing when the subject moves hands off of hips or puts a foot down. Make sure the subject looks at a non-moving target 4-12 feet ahead. Repeat on other side.</td>
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<tr>
<td>4.</td>
<td><strong>COMPENSATORY STEPPING CORRECTION-FORWARD</strong> Stand in front of the subject with one hand on each shoulder and ask the subject to lean forward (Make sure there is room for them to step forward). Require the subject to lean until the subject’s shoulders and hips are in front of toes. After you feel the subject’s body weight in your hands, very suddenly release your support. The test must elicit a step. NOTE: Be prepared to catch subject.</td>
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<tr>
<td>5.</td>
<td><strong>COMPENSATORY STEPPING CORRECTION - BACKWARD</strong> Stand behind the subject with one hand on each scapula and ask the subject to lean backward (Make sure there is room for the subject to step backward.) Require the subject to lean until their shoulders and hips are in back of their heels. After you feel the subject’s body weight in your hands, very suddenly release your support. Test must elicit a step. NOTE: Be prepared to catch subject.</td>
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<td>6.</td>
<td><strong>COMPENSATORY STEPPING CORRECTION- LATERAL</strong> Stand to the side of the subject, place one hand on the side of the subject’s pelvis, and have the subject lean their whole body into your hands. Require the subject to lean until the midline of the pelvis is over the right (or left) foot and then suddenly release your hold. NOTE: Be prepared to catch subject.</td>
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<tr>
<td>7.</td>
<td><strong>STANCE (FEET TOGETHER); EYES OPEN, FIRM SURFACE</strong> Record the time the subject was able to stand with feet together up to a maximum of 30 seconds. Make sure subject looks at a non-moving target 4-12 feet away.</td>
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<tr>
<td>8.</td>
<td><strong>STANCE (FEET TOGETHER); EYES CLOSED, FOAM SURFACE</strong> Use medium density Temper® foam, 4 inches thick. Assist subject in stepping onto foam. Record the time the subject was able to stand in each condition to a maximum of 30 seconds. Have the subject step off of the foam between trials. Flip the foam over between each trial to ensure the foam has retained its shape.</td>
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<td>9.</td>
<td><strong>INCLINE EYES CLOSED</strong> Aid the subject onto the ramp. Once the subject closes eyes, begin timing and record time. Note if there is excessive sway.</td>
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<td>10.</td>
<td><strong>CHANGE IN SPEED</strong> Allow the subject to take 3-5 steps at normal speed, and then say “fast”. After 3-5 fast steps, say “slow”. Allow 3-5 slow steps before the subject stops walking.</td>
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<tr>
<td>11.</td>
<td><strong>WALK WITH HEAD TURNS- HORIZONTAL</strong> Allow the subject to reach normal speed, and give the commands “right, left” every 3-5 steps. Score if you see a problem in either direction. If subject has severe cervical restrictions allow combined head and trunk movements.</td>
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<tr>
<td>12.</td>
<td><strong>WALK WITH PIVOT TURNS</strong> Demonstrate a pivot turn. Once the subject is walking at normal speed, say “turn and stop.” Count the number of steps from “turn” until the subject is stable. Imbalance may be indicated by wide stance, extra stepping or trunk motion.</td>
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<td>13.</td>
<td><strong>STEP OVER OBSTACLES</strong> Place the box (9 inches or 23 cm height) 10 feet away from where the subject will begin walking. Two shoeboxes taped together works well to create this apparatus.</td>
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<td>14.</td>
<td><strong>TIMED UP &amp; GO WITH DUAL TASK</strong> Use the TUG time to determine the effects of dual tasking. The subject should walk a 3 meter distance. TUG: Have the subject sitting with the subject’s back against the chair. The subject will be timed from the moment you say “Go” until the subject returns to sitting. Stop timing when the subject’s buttocks hit the chair bottom and the subject’s back is against the chair. The chair should be firm without arms. TUG With Dual Task: While sitting determine how fast and accurately the subject can count backwards by threes starting from a number between 100-90. Then, ask the subject to count from a different number and after a few numbers say “Go”. Time the subject from the moment you say “Go” until the subject returns to the sitting position. Score dual task as affecting counting or walking if speed slows (&gt;10%) from TUG and or new signs of imbalance.</td>
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