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The Balance Evaluation Systems Test (BESTest)
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Presentation Overview

Origin of the BESTest
Structure and Breakdown of the BESTest
Mini-BESTest
Evidentiary Support
BESTest Limitations
BESTest vs. Mini-BESTest

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Presentation Overview

- Origin of the BESTest
- Structure and Breakdown of the BESTest
- Mini-BESTest
- Evidentiary Support
- BESTest Limitations
- BESTest vs. Mini-BESTest

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Background

- "Current clinical balance assessment tools do not aim to help therapists identify the underlying postural control systems responsible for poor functional balance."
  - Horak, Wrisley, Frank, PTJ, 2009
- Current tools screen for balance problems and predict fall risk, but do not help to direct treatment
- Current assessments primarily target elderly with significant impairments
- Underlying theme of the BESTest = Identify disordered system(s)

BESTest can direct specific types of intervention
Structure of the BESTest

- Consists of 27 tasks with some items comprising sub-items, total of 36 items
- 17 items (36%) - adapted from previously validated balance assessments
  - BBS, DGI, SL, TUG, Functional Reach Test, and modified CTSIB
- Remaining 19 novel items - dual task, postural response & compensatory stepping, general alignment in standing/transitioning, leaning and returning to vertical, standing on an incline from flat, transferring from sit to stand
- Each item is scored on a 4-level ordinal scale from 0 (worst performance) to 3 (best performance)
- Entire test takes about 30 minutes to complete
- Evaluates 6 postural control systems contributing to balance
- Subjects should be tested with flat-heeled shoes or with shoes and socks off

Scoring the BESTest

- If subject must use an assistive device for an item, score that item one category lower.
- If subject requires physical assistance to perform an item, score the lowest category (0) for that test.

EFFECTIVE CONTROL SYSTEMS EVALUATED BY THE BESTEST

Physical Therapy Journal
The Balance Evaluation Systems Test (BESTest) to Differentiate Balance Deficits
Horak, Wrisley, Frank
2009
1. Biomechanical Constraints

Constraints on the biomechanical system (e.g., ankle/hip weakness, knee joint alignment or pain) difficulty employing ankle strategy or compensatory strategies for

2. Quality of the base of support
   - Item 1
   - Geometric postural alignment

3. Functional ankle and hip strength for standing – force generating capacity
   - Item 2
   - Ability to lower oneself to the floor and then rise from the floor to a standing position

4. Geometric postural alignment
   - Item 3
   - Functional ankle and hip strength for standing – force generating capacity

5. Items 3 & 4
   - Ability to lower oneself to the floor and then rise from the floor to a standing position
   - Item 5

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1. Biomechanical Constraints

1. Base of support
   - Normal, lack of base of support with no deviations or pain
   - Normal, lack of deviation and no pain
   - Normal, lack of deviation and no pain

2. Geometric postural alignment
   - Normal, no deviation, no scoliosis
   - Normal, no deviation, no scoliosis
   - Normal, no deviation, no scoliosis

3. Functional ankle and hip strength for standing – force generating capacity
   - Normal, no deviation, no scoliosis
   - Normal, no deviation, no scoliosis
   - Normal, no deviation, no scoliosis

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4. Functional ankle and hip strength for standing
   - Normal, no deviation, no scoliosis
   - Normal, no deviation, no scoliosis
   - Normal, no deviation, no scoliosis

5. Time to floor and stand up
   - Normal, no deviation, no scoliosis
   - Normal, no deviation, no scoliosis
   - Normal, no deviation, no scoliosis

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Internal representation of how far the body can move over its BOS before changing the support or losing balance
- Internal perception of postural vertical
- Internal representation of gravity

Lateral limits of stability in a sitting posture with EC & ability to realign the trunk and head back to perceived vertical:
- Item 6
- Ability to reach maximally forward and laterally while maintaining lateral limits of stability:
- Items 7 & 8

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<table>
<thead>
<tr>
<th>#</th>
<th>Task</th>
<th>Soft Rate</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Reach left, without visual guidance, to touch fingers to right side of face.</td>
<td>Low</td>
<td>Significant deviation or inability to touch fingers to right side of face.</td>
</tr>
<tr>
<td>2</td>
<td>Reach left, without visual guidance, to touch fingers to right side of head.</td>
<td>Low</td>
<td>Significant deviation or inability to touch fingers to right side of head.</td>
</tr>
<tr>
<td>3</td>
<td>Test ability to maintain vertical body position while reaching left.</td>
<td>Low</td>
<td>If unable to maintain vertical body position while reaching left.</td>
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</tbody>
</table>
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Tasks that require an active movement of the body’s COM in anticipation of a postural transition from one body position to another:

- Sitting to standing
- Normal stance to stance on toes
- 2-legged stance to 1-legged stance
- Resting with the arm hanging in anticipation of being a break in arm motion
- Rapid bilateral arm raises with a weight

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4. Postural Responses

- Both in-place and compensatory stepping responses in all four quadrants
- Induced by the examiner’s hands using “push and release” technique

Isometric push with the patient’s feet in place (ankle/hip strategy)
- Items 14 & 15

Inducing compensatory stepping strategies & forward, backward, or lateral lean of the patient over the BOS prior to the release of pressure
- Items 16, 17, & 18

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5 Sensory Orientation

- Identifies any increase in body sway during stance associated with altering visual or somatosensory information for control of standing balance

Modified CTSIB
- Item 19
  Standing on a 10 degree toes-up incline with EC
- Item 20

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6 Stability in Gait

- Evaluation of balance during gait
- Item 1
- Changing gait speed
- Item 2
- Fixed rotations during gait
- Item 3
- Gait with pivot turns
- Item 4
- Stepping over obstacles
- Item 5

- Timed Up & Go
- Item 6
- Timed Up & Go with secondary cognitive task to challenge the patient’s attention
- Item 7
Mini-BESTest

14-item scale
Focuses on dynamic balance
Includes items from the original BESTest
Sections:
- Anticipatory Postural Adjustments
- Postural Responses
- Sensory Orientation
- Balance during Gait
If subject needs an assistive device for an item, score that item one category lower.
If subject requires physical assistance to perform an item, score the lowest category (0) for that item.

Mini-BESTest

1. STAND
   - Can stand with eyes closed for 10 seconds?
   - SN: Normal
   - Score: 3

2. WALK TO TASK
   - Can walk 20 ft with eyes closed and hold the side of the wall?
   - SN: Normal
   - Score: 2

3. COMPARATOR: STEPPING CORRECTION: BACKWARD
   - Can step backward 3 steps from the original step position?
   - SN: Normal
   - Score: 2

4. COMPARATOR: STEPPING CORRECTION: LATERAL
   - Can step laterally 3 steps from the original step position?
   - SN: Normal
   - Score: 2

5. EYES OPEN, FIRM SURFACE (FEET TOGETHER)
   - Can walk 3 steps on the firm surface?
   - SN: Normal
   - Score: 3

6. EYES CLOSED, FIRM SURFACE (FEET TOGETHER)
   - Can walk 3 steps on the firm surface?
   - SN: Normal
   - Score: 3
Mini-BESTest

- 8. INCLINE-FACEUP CURVED:
  - Patient stands on a raised surface.
  - Balance is maintained for 10 seconds and rotated forward.

- 10. CHANGE IN GAIT SPEED:
  - Balance is maintained while walking at different speeds.

- 15. WALK WITH HEAD TURNS - HORIZONTAL:
  - Balance is maintained while walking with head turns.

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Mini-BESTest

- 12. WALK WITH-OUT TURN:
  - Balance is maintained while walking.

- 13. Checklist:
  - Balance is maintained while performing additional tasks.

- 15. Gait and Balance:
  - Balance is maintained while sitting on a raised surface.

Evidentiary Support
for the BESTest & Mini-BESTest

- Considered to be the most comprehensive clinical balance tool available.
- Intraclass Correlation Coefficient (ICC) for interrater reliability for the test is as high as 0.91.
- Consistent evidence of a statistically significant difference between fallers and non-fallers.
- Level of balance impairment associated with falling in individuals with PD:
  - 69% on the BESTest
  - 63% on the Mini-BESTest
- Concurrent validity of the correlation between the BESTest and Activities-specific Balance Confidence (ABC) Scale.
- Avoids ceiling and floor effects.
- Mini-BESTest demonstrates high construct and concurrent validity.
- Mini-BESTest is more effective than the BBS for predicting UPDRS motor score and for discriminating between those with and without postural response deficits.
Evidentiary Support (Continued)

Functional Gait Assessment and Balance Evaluation System Test: Reliability, Validity, Sensitivity, and Specificity for Identifying Individuals With Parkinson Disease Who Fall
Angelo L. Leddy, Beth E. Crowner and Gammon M. Earhart

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• Purpose: compare the FGA & BESTest with the BBS among individuals with PD
• Methods: n = 80; 25 fallers (2 or more falls in the past 6 months): observational study
• Results:
  - Test-retest reliability was 0.80 for BBS, 0.91 for FGA, 0.88 for BESTest
  - Correlation (BBS vs. FGA) = 0.86
  - Correlation (BBS vs. BESTest) = 0.79
  - Correlation (FGA vs. BESTest) = 0.89

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• Purpose: examine the validity of the BESTest to identify balance impairments in people with MS
• Methods:
  - 13 subjects with MS, 13 subjects without MS
  - Assessments included BESTest, fall history, and force plates and motion capture during lab tasks of step initiation, forward leaning to the limits of stability, and postural responses to rotations of the support surface
• Results:
  - Subjects with MS mean score = 91; Without MS = 105
  - Subjects with MS scored lower on mechanical constraints, limits of stability, anticipatory postural adjustments, and gait
  - BESTest scores significantly correlated with objective laboratory measures of step velocity during step initiation as well as center-of-pressure displacements
  - BESTest total score was 96% accurate for discriminating between fallers and non-fallers, and BESTest scores significantly correlated with EDSS scores

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Psychometric Properties of the Mini-Balance Evaluation Systems Test (Mini-BESTest) in Community-Dwelling Individuals With Chronic Stroke
Charlotte S.L. Tsang, Lin-Rong Liu, Raymond C.K. Chung, Maria Y.C. Pang

• Purpose: to examine the reliability and validity of the Mini-BESTest and its accuracy in categorizing people with stroke based on fall history
• Methods: 106 people with chronic stroke and 48 controls; observation measurement study with a test-retest design
• Results:
  - Mini-BESTest had excellent internal consistency, intra- & inter-rater reliability
  - Microstate change in Mini-BESTest demonstrated significant differences in stroke vs. control groups and fallers vs. non-fallers in the stroke group
  - Mini-BESTest better evaluates fine and closing effects as compared to other standardized measures
  - Mini-BESTest has the ability to clearly measure patient vs. control (ratio 3)
  - The Mini-BESTest questions did not yield ratios of 1.
BESTest Limitations

Possible that other systems responsible for balance control are missing from the test:
- Vestibuloocular reflex
- Dynamic visual acuity testing
- Only 1 item related to cognitive constraints
- Construct validity: Do the sections of the BESTest accurately detect dissociable balance deficits?
- Sections 1 & 2 should be revised to improve their test-retest reliability
- Language... or is it?
- MMT +
- Rhomboids +
- CTSIB +
- Berg Balance Test +
- Dynamic Gait Index +
- Postural responses = 40–50 min

BESTest vs. Mini-BESTest

Time constraints
- Unique to each setting
- What works best for your clinic?

Mini-BESTest = discriminative properties for identifying falls in PD patients comparable to-slightly greater than the original BESTest

Mini-BESTest focuses on dynamic balance only
- Strength and limits of stability represent significant predictors of future falls
- Utilize the original BESTest?

LAB PRACTICE
References


