Suitability of the Berg Balance Scale for Assessments of Patients with Unilateral Transtibial Amputation

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OAAC Conference May 12, 2006

Effects on Balance Following Amputation

Balance

Visual &

Vestibular Systems

Afferent Input
-Reduced somatosensory & proporioceptive feedback
- Aberrant sensation from phantom limb pain

Efferent Output
-Altered basic movement biomechanics
-Missing part of the limb disturbs postural control mechanisms

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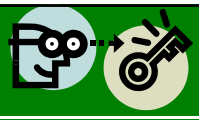


Rationale for Study

- Need for a balance outcome measure for the amputee population
- Ideal measuring instrument must be clinically applicable, reliable, valid, and responsive
- Lack of a balance assessment tool specifically designed for the amputee population
- How about the Berg Balance Scale?

Berg Balance Scale (BBS)

(Berg et al, 1989, 1992)

Concurrent Criterion Validity

- BBS Scores correlated moderately (r=0.39 – 0.62) with caregiver clinical judgements and self-ratings in 113 residents of a home for seniors
- BBS Scores correlated moderately (r= -0.55) with laboratory measures of spontaneous sway in 31 elderly individuals

Predictive Criterion Validity

- One of the significant predictors (along with visual deficits and a recent fall) of the occurrence of multiple falls over the following year in 113 elderly

Construct Validity

- BBS Scores correlated strongly with functional and motor performance on the Barthel Index and Fugl-Meyer Scale (r=0.62 – 0.94)

Reliability

- Strong internal consistency (Cronbach's alphas > 0.83 for elderly residents and >0.97 for stroke patients)
- Excellent intra-rater (ICC= 0.97) and inter-rater (ICC= 0.98) reliability.

Objectives of the Study

To assess the appropriateness of the BBS for evaluating balance in patients with dysvascular, unilateral, transtibial amputation by examining:

1. **Any directional effects**
2. **Psychomtric properties of the BBS**
3. **The internal consistency**

Method

- 15 patients with unilateral, transtibial amputation were recruited at West Park Healthcare Centre within 4-12 weeks of initial prosthetic fitting.
- Participants were asked to perform all 14 activities of the BBS on a single occasion.
- A physiotherapist was the evaluator of the score for each item.
- For directional items (item # 11: turning 360^{o}; item # 13: tandem standing; item # 14: standing on one foot), patients were asked to start with the leg of choice. Then the same item was tested using the opposite leg.

Statistical Analyses

Directional Effects

- Wilcoxon signed-rank test

Floor and Ceiling Effects

- A percentage of responses at the bottom or top of the range of the scale for each item (> 20% for BBS with 5 ranks for each item)

Internal Consistency

- Cronbach's α statistic

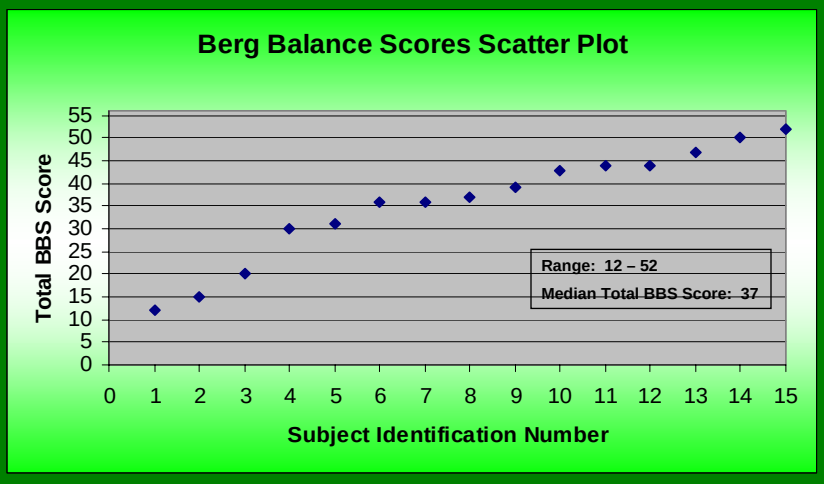
Results

Demographics (n=15)	
Age	74.0 ± 6.7 yrs
Gender	12 men (80%) 3 women (20%)
Time since amputation	4.3 ± 2.6 months (n = 14)
Right-sided Amputation	9 (60%)
Left-sided Amputation	6 (40%)

Results: Mobility Aids

This Study on a Sample of Patients with Unilateral Transtibial Amputation				Berg et al (1992)			
Mobility Aid	N = 15	BBS Scores Mean	Range	Mobility Aid	N = 113	BBS Scores Mean	CI
Single Cane	n = 3	48.6 ± 4.2	44 - 52	No Aids	n = 49	49.6 ± 5.6	47.9 – 51.1
Double Canes	n = 2	25.5 ± 9.1	12 - 39	Cane Outdoors	n = 26	48.3 ± 3.2	47 – 49.6
Double Crutches	n = 5	31.6 ± 6.8	30 - 47	Cane Indoors	n = 29	45.3 ± 3.4	44 – 46.5
Walker	n = 5	36.2 ± 13.4	15 - 44	Walker	n = 9	33.1 ± 8.4	26.7 – 39.6

Findings (Berg Balance Scores)



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Wilcoxon Analysis of Directional Dependent Items

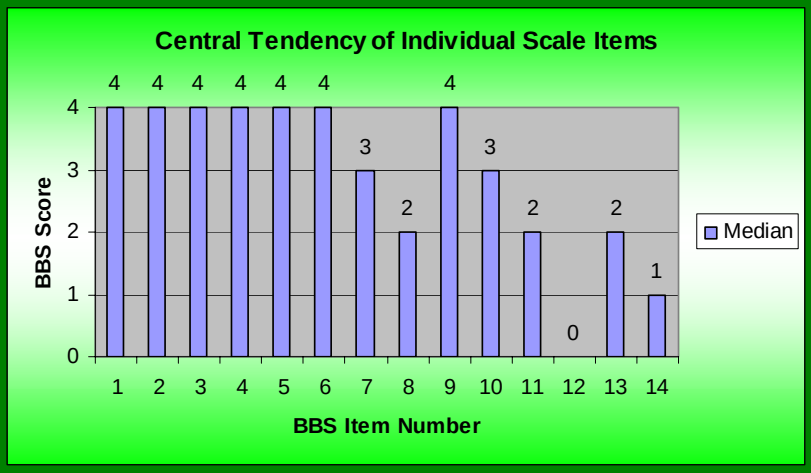
Item	Negative Ranks	Positive Ranks	Ties	p Value
Turning 360º (toward prosthesis vs intact leg)	1 (6.7%)*	1 (6.7%)	13 (86.7%)	p = 0.655
Standing (prosthetic ahead vs behind)	3 (20%)†	0	12 (80%)	p = 0.102
Standing on one foot (prosthesis vs intact leg)	3 (20%)‡	0	12 (80%)	p = 0.102

*Turning 360º (toward intact leg) < Turning 360º (toward prosthesis)

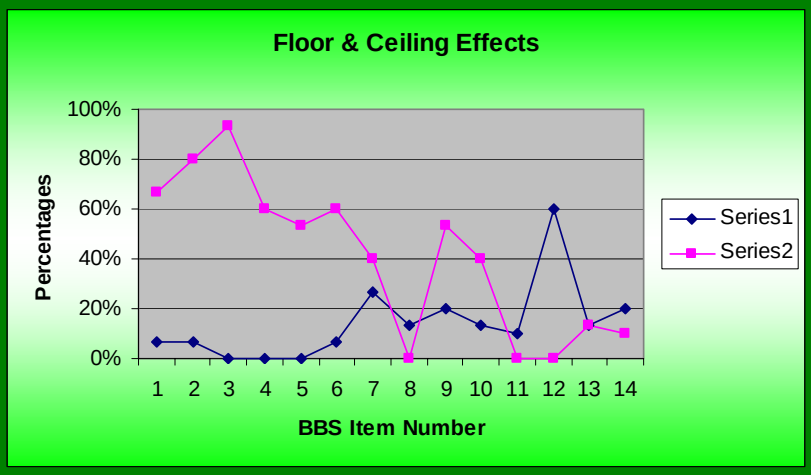
†Standing, prosthetic behind < Standing, prosthetic ahead

‡Standing on prosthesis < Standing on remaining leg

Findings (Central Tendency)



Floor and Ceiling Effects of Individual Scale Items



Findings (Internal Consistency)

- The intercorrelation among the individual items of the BBS was high, as indicated by the Cronbach's α value of 0.95.
- When individual items were removed in a stepwise fashion to evaluate the individual contributions to the overall internal consistency, the α values remained high with a range of 0.944 – 0.954

Discussion: Directional Dependent Items

No directional effects were detected on the items whose performance might have an element of directional bias depending on the side of amputation:

Item # 11: Turning 360°

Item # 13: Standing unsupported with one foot directly in front of the other

Item # 14: Standing on one foot

Clinical Implications: When applying the BBS to this clinical population with unilateral transtibial amputation, it is acceptable to allow the patient to choose how to respond.

- This is consistent with instructions outlined by Berg et al (1989)

Discussion: Psychometric Properties

The appropriateness of the BBS in this population with unilateral transtibial amputation was evaluated by assessing the following:

(i) whether the measure of central tendency approached the midpoint of the distribution

(ii) whether the range of the scores demonstrated the variability in the study sample

(iii) whether floor and ceiling effects were minimal.

Ceiling effects: noted in many of the less challenging items (# 1- # 7, # 9 & # 10)

Floor effects: noted in later, most challenging items (# 7- standing with feet together; #12-placing alternate foot on stool)

Discussion: Psychometric Properties


Picture 14 Picture 15

Substantial floor effect in Item # 12 (placing alternate foot on stool): 60% of the subjects could not score above a zero.

Clinical Implications:

Moving the intact limb while balancing on the amputated limb with the prosthesis appears to be particularly difficult for this population.

Nonetheless, very few patients were unable to at least attempt some of the more challenging tasks.

NB: Floor and ceiling effects were entirely absent for the overall BBS scores.

Clinical Implications:

The BBS is appropriate for the clinical evaluation of balance performance in patients with transtibial amputation.

Discussion: Internal Consistency

Intercorrelation among the individual items of the BBS as indicated by the Cronbach's α value of 0.95 was high.

This value was remarkably close to the Cronbach's α value of 0.96 reported by Berg et al (1989)

Clinical Implications:

The high Cronbach's α value suggests that the BBS is not susceptible to mechanical limitations imposed by the prosthesis, but is a reliable measure of a patient's inherent balance ability.

Conclusion

- **Key findings of this study indicate that the BBS (i) is not subject to the effects of the side of amputation, (ii) is not subject to floor or ceiling effects, and (iii) has good internal consistency.**
- **The BBS is an appropriate clinical tool for assessing balance among patients with unilateral, transtibial amputation and may be used by clinicians specializing in amputee rehab.**

Study Limitations

- **Relatively small sample size of convenience**
- **Only a segment of the amputee population studied: extrapolated to only unilateral, transtibial amputation**
- **Future studies:**
  - A potential streamlined BBS for the population with unilateral transtibial amputation
  - Applicability of the BBS to patients with amputations at other levels
  - Sensitivity of the BBS for assessing changes in balance over time among patients with unilateral, transtibial amputation;
  - Potential for the BBS to predict fall risk in this population

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Thank you

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