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Harold L. Merriman

Kurt Jackson

Michael Breneman

Amy Collins

Tiffany McEldowney

See next page for additional authors

Authors

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Harold Merriman, Kurt Jackson, Michael Breneman, Amy Collins, Tiffany McEldowney, Ashton Swinford

University of Dayton Department of Physical Therapy

Introduction

Each year one in three adults ≥ 65 years old falls which results in significant morbidity, mortality and health care costs.[1] Commonly used balance tests such as the Balance Evaluation Systems Test, Berg Balance Scale and Tinetti produce numerical results that have been correlated with a fall history. However, these tests can be complicated, time consuming, require a large amount of space, may require special tools for assessment and exhibit a ceiling effect.[2] Additionally, dynamic balance recovery strategies such as rapid stepping movements may not be fully assessed by some of these other traditional tests.

Purpose

To examine the use and practicality of a new, portable and easy to administer dynamic balance test called the *Rapid Step Test* (RST) in older adults that will differentiate between fallers and non-fallers.

Subjects

43 community ambulators participated in the initial phase of this study. Subjects were 65-84 years old and did not require an assistive device for ambulation. Exclusion criteria including the following: lower extremity surgical history, acute orthopedic condition, neurologic or balance disorder, vestibular dysfunction, and amputation. 22 Non-fallers and 21 Fallers were analyzed. Subjects were asked if they had fallen within the last 6 months before RST testing; 14 subjects reported 1 fall (Single Faller) and 7 subjects reported >1 fall (Multiple Faller).

Methods

Participants completed a written informed consent. Subject height, weight, resting blood pressure and resting heart rate were obtained. Leg length was measured in standing as the distance between the ASIS and medial malleolus. Per the fall history questionnaire, subjects were divided into three groups: Non-Fallers (NF), Single Fallers (SF) and Multiple Fallers (MF). The RST in all 5 directions was completed for both lower extremities at 50% and 75% of subject's leg length (Figures 1-3). After two warm up trials in each direction, subjects were instructed to take as many steps as possible within 15 seconds at the designated step length. As needed, two spotters were used to ensure subject safety during stepping. Full weight shift onto the stepping leg was required in order to count as a full step. A 30-second rest break was given between each stepping direction.

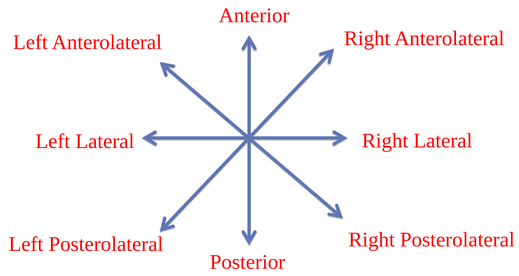

Figure 1. Directions used for RST.

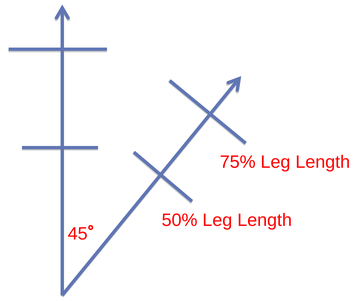

Figure 2. RST 45° angle made with tape marked at the appropriate leg length percentages.

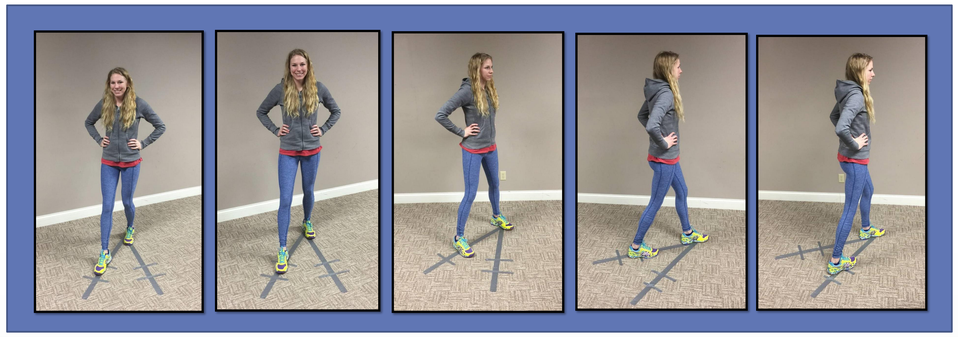

Figure 3. RST directions for the right stepping leg at 50% of leg length. Directions for the left stepping leg would be a mirror image. The same technique was used for 75% leg length stepping in all directions.

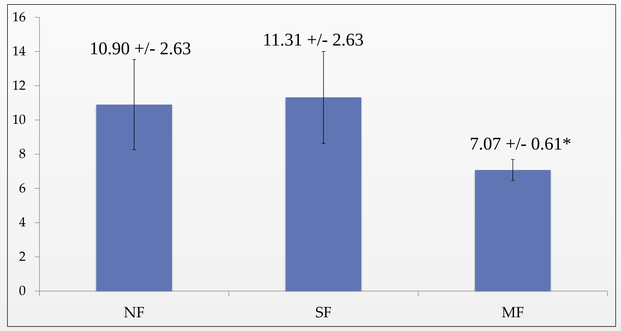

Figure 4. Grand mean of steps ± SD completed by fall risk categories. * p ≤ 0.05 NF=Non-Fallers, SF=Single Fallers, MF=Multiple Fallers.

	50% Leg Length		75% Leg Length	
	Right	Left	Right	Left
NF	11.82 ± 3.93	12.13 ± 3.91	9.90 ± 3.11	9.75 ± 2.96
SF	12.33 ± 3.83	12.18 ± 3.85	10.33 ± 3.03	10.44 ± 3.01
MF	7.47 ± 2.47	7.74 ± 2.70	6.56 ± 2.80	6.54 ± 2.45

Table. Mean steps ± SD completed between fall risk categories at varying step lengths.

Statistical Analysis

Statistic Product for Statistical Solutions (SPSS) version 20.0 was used to analyze data. Independent Samples t-tests were used to compare demographic information for age, height, and BMI. A repeated measures analysis of variance (ANOVA) was used to measure step direction and fall risk, with step direction as the within-group factor, and fall risk as the between group factor. P-value for significance was set at p ≤0 .05.

Results

Independent t-tests were not significant for age, height, and BMI (p>.05). There were no significant differences within-groups for step repetitions with either step length or direction (Table). The repeated measures ANOVA revealed significance between-subjects effects for fall risk and mean step repetitions. Bonferroni *post-hoc* analyses revealed significant differences between the NF and MF (3.83 ± 1.28, p=.014, 95% CI 0.63-7.37), and SF and MF (4.24 ± 1.36, p=.010, 95% CI 0.83-7.65). A grand mean average of all steps completed was calculated (NF=10.90±2.63, SF=11.31±2.68, MF=7.07±0.61) (Figure 4).

Discussion

The RST is a new, portable and easy to administer test that requires little space or equipment. It also differentiates between older adults who are multiple-fallers and non-fallers based on rapid stepping at both 50% and 75% of leg length. Lastly, all directions of timed rapid stepping were able to discriminate multiple-fallers from non-fallers thus potentially allowing for the future development of a shorter and quicker RST version.

Clinical Relevance

The RST is easy to administer and can differentiate between non-fallers and multiple fallers. Further research is needed to determine the test's ability to predict future falls as compared to other instruments and how the results can be used to guide interventions.

References

1) Centers for Disease Control and Prevention. Falls Among Older Adults: An Overview. http://www.cdc.gov/homeandrecreationalsafety/falls/adultfalls.html. Published September 20, 2012. Accessed July 12, 2013.

2) Fuller G. Falls in the Elderly. *American Family Physician.* 2000; 61(7): 2159-2168