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Rapid Step Test Based on Leg Length as a Novel Dynamic Standing Balance Test in the Geriatric Population: A Pilot Study

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Introduction

Each year, 1 out of 3 adults over age 65 experience a fall resulting in a traumatic injury or even mortality. Falls are the leading cause of death in the elderly population and cause the greatest number of hospital admissions from trauma. The Balance Evaluation Systems Test (BEST), Berg Balance Scale, and Tinetti are frequently used tests to determine fall risk. However, they can be complicated, time consuming, and exhibit a ceiling effect. This study employed the Rapid Step Test (RST) to examine the use and practicality of a new, portable and easy to administer test that may differentiate between fallers and non-fallers.

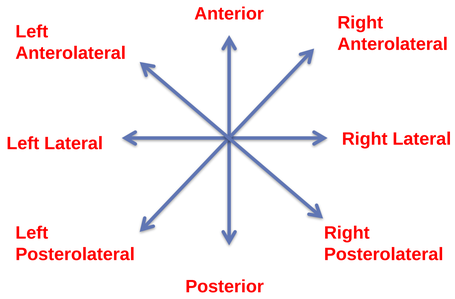

Figure 1 Demonstrates directions performed with RST.

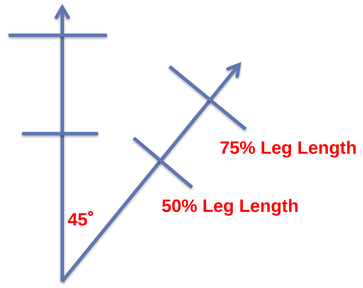

Figure 2 RST grid made with masking tape, goniometer, and a tape measure was utilized to construct a 45 angle on the floor with markings at the appropriate measurements for leg length percentages.

Methods

Participants completed written informed consent and resting blood pressure along with heart rate measurements were obtained. Per the fall history questionnaire, subjects were divided into three groups: Non-Fallers (NF), Single Fallers (SF) (1 fall in past 6 mo.), and Multiple Fallers (MF) (>1 fall in past 6 mo.). The RST was completed in five directions (anterior, anterolateral, lateral, posterior, posterolateral) for each lower extremity at 50% and 75% of the subject's leg length. Subjects were instructed to take as many steps as possible within 15 seconds. Full weight shifting was required on the stepping leg in order to count as a full step.

Purpose

The purpose of this study was to identify differences in RST performance between non-fallers, single fallers (fallen once in the last six months), and multiple fallers (fallen two or more times in the last six months).

Hypothesis

Our hypothesis was that the Rapid Step Test will identify differences between fallers and non-fallers and that it will be easily administered in the older adult population.

Subjects

70 community ambulators (33 males, 37 females) aged 65-84 who did not use an assistive device participated in the study. 40 subjects were classified as non-fallers, 20 as single fallers, and 10 subjects were multiple fallers.

Materials

Tape, goniometer, tape measure, gait belt, stopwatch

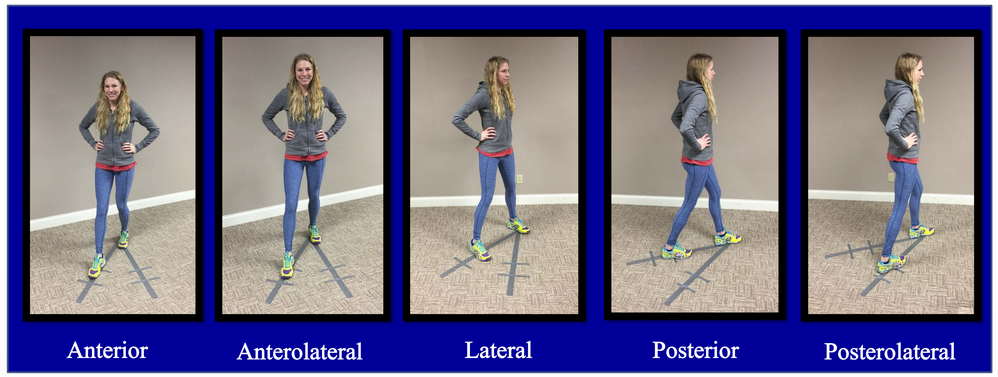

FIGURE 3 Directions for RST for the left supported leg and right stepping leg at 50% of leg length. Directions for left stepping leg would be mirror images from pictures above. Same technique was utilized for 75% leg length in all directions.

Stepping Leg and Direction	Significance Level Between Non-Fallers and Multiple Fallers	
	50% Leg Length	75% Leg Length
Right Anterior	.013	.026
Left Anterior	.014	.005
Right Anterolateral	.012	.003
Left Anterolateral	.034	.003
Right Lateral	.027	.004
Left Lateral	.006	.004
Right Posterolateral	.036	.004
Left Posterolateral	.019	.004
Right Posterior	.010	.008
Left Posterior	.044	.012

TABLE Results from Tukey post-hoc analyses demonstrating significance of predicting fall risk between non-fallers and multiple fallers for 50% and 75% stepping length using the RST. Each of the 10 directions produced significant values between the two groups for 50% and 75% step length. Significance was taken at a $p < 0.05$ level.

Results

One-Way ANOVA was utilized for this study with Tukey *post-hoc* analysis revealing significant differences ($p < .05$) between NF and MF in 10-of-10 directions for both 50% and 75% leg length steps (see Table). When comparing SF and MF, significant differences ($p < .05$) were found for 5-of-10 directions with the 75% leg length step as opposed to only 1-of-10 directions for the 50% leg length step. The null hypothesis was rejected, and it can be concluded that the RST distinguishes between NF and MF in all directions. The 75% leg length RST is best at distinguishing between SF and MF.

Discussion

Reducing falls in the elderly population is a critical concern. Few studies have looked at dynamic balance with an emphasis on rapid stepping of the lower extremities to identify fall risk in elderly patients. While this study found significant stepping differences when comparing fallers and non-fallers, future research will focus on making the RST easier to administer by streamlining the test along with deciphering if there is a difference in fall risk when assessing dominant vs. non-dominant legs.

References

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