
Abstract

The ability to maintain balance during activities of daily living is critical to maintaining an independent life style. Many of the currently available clinical tests used to examine balance were developed for use in the elderly. Many of these tests have been found to have a low ceiling effect, i.e. the test results are normal until the subject has a serious and obvious balance impairment. The Star Excursion Balance (Star) Test is a measure of dynamic balance performed in single leg stance. The Star Test was developed using subjects 20-39 years of age. The first article published on the Star Test (Kineezy, JOSP 1998) reported poor test-retest reliability. However, Hertel (J Sport Rehab 2008) and Stockert (JOSP 2002) modified the methodology and showed that the Star Test could be performed with high test-retest and intertester reliability in young subjects (20-39 years old). The validity and sensitivity of the Star Test have not been determined. The purpose of this study was: 1) to compare Star Test performance in subjects ≥60 years old with 20-39 y.o. and 40-59 y.o. subjects; 2) to determine the correlation between the subject age and performance on the Star Test; and 3) to perform regression analysis using age and Star Test performance. 

SUBJECTS were community dwelling adults able to walk and stand independently. Participants were excluded if they were unable to stand independently in single leg stance for at least 10 seconds or if they had any balance impairment. Subjects were divided into 2 groups: young (20-39 y.o. n=78) middle (40-59 y.o. n=75) and geriatric group (≥ 60 years of age, n=79). 

PROTOCOL: Subjects stood barefoot with their stance foot placed in the center of the Star Grid. The foot was positioned with the medial and lateral heel联ined aligned with line 1C-2C while their second toe and calcaneus were aligned with line 1A-1E (see Figures 2). When the subject stood on the right lower extremity (LE) they reached with their left LE toward the 5 lines that begins with the number 1 (1A-1E). When standing on the left LE, they reached with the right LE toward the 5 lines that begins with the number 2 (2A-2B). Each line was made from a tape measure with the “zero point” at the intersection of the lines in the center of the Star Grid. Subjects were instructed to reach as far as possible without a loss of balance and “tap” the great toe on the designated lines. If a subject shifted their weight onto the reaching LE the trial was disallowed and the subject repeated the move. Subjects were required to keep the stance foot flat on the grid and to minimize the amount of counter-balancing by keeping the arms relaxed at their sides. “Reach” was quantified by reading the point on the tape measure that matched the furthest excursion of the great toe. Subjects performed 3 trials for each of the 10 movements (5 movements for each LE). 

DATA ANALYSES: Data was analyzed using SPSS v15.0. An ANOVA was used to compare group physical characteristics. The 3 trials for each movement of the Star Test were converted to a mean for each movement and an overall test mean. “Normalized reach” was determined by dividing reach by subject height. An ANOVA was used to compare normalized reach between the 3 groups. The strength of the relationship between age and normalized reach was examined using a Pearson rho (r) for parametric data. Nonlinear regression analysis was performed using age and normalized reach. 

Using ANOVA we found no significant differences between the groups in terms of height or weight. The average age of each group was different by design. Using ANOVA we determined that there was a significant difference in Star Test performance between the geriatric group versus the young and middle groups for each movement and the overall test summary score (see Table 1). In each comparison the geriatric group reached significantly less in inches (reach) and as a % of their height (normalized reach). There were significant correlations between reach (inches) and height & weight; but not normalized reach (% of subject height) and height & weight (see Tables 2 & 3). We found a significant negative correlation between age and reach (r = -0.51 to -0.66) & age and normalized reach (r = -0.57 to -0.67). Nonlinear regression analysis using age and normalized reach found the coefficient of determination (r²) to be 0.47. 

1) Our groups were not significantly different in terms of height and weight, but they were different in age (by design). 
2) The geriatric group reached significantly less than the other groups in inches and as a % of the subject’s height.
3) While there was a positive correlation between subject height and reach there was no correlation between subject height and normalized reach. Height has no impact on how far a subject can reach when reach is expressed as a % of subject height.
4) Performance on the Star Test decreased significantly with advancing age. There was a significant negative correlation between age and the distance a subject reached in inches and as a % of subject height; i.e. as subjects get older they cannot reach as far.
5) The coefficient of determination (r²) from our quadratic regression model was 0.47, therefore age accounts for 47% of the information need to predict normalized reach in a subject.

In future studies we hope to determine: 1) if adding BMI to our regression equation will improve r²; and 2) if there is a threshold for normalized reach that could be used to determine if someone has impairment in balance.