A NOVEL DEVICE FOR THE ASSESSMENT OF BALANCE IN THE ELDERLY

Introduction: Falling is the primary mechanism for hip fracture in the elderly and therefore represents a major health concern. Impaired balance, muscle weakness and impaired gait are important risk factors for falling in the elderly (Daley and Spinks, 2000). Balance is typically assessed according to various kinetic and kinematic measurements of body sway while patients stand on one or two legs on a force plate and/or are viewed by a motion analysis system (Tanaka et al 1999). However, these tests require expensive, non-portable equipment and the acquired data can require time-consuming post-processing. The cost and complexity of these tests renders them impractical for a wide clinical application. Alternative assessments of balance requiring less expense and less technical instrumentation have relied on more subjective assessments of balance performance and subsequently have poor generalizability (Topper et al 1993). A valid objective balance test, using inexpensive portable instrumentation that yields quick and easily interpretable results, would have a wide clinical application. For example, this would afford the opportunity to perform balance assessments on large numbers in senior citizen’s centers or nursing homes. The purpose of this study was to test the construct validity of a novel instrument for the assessment of balance i.e. does the instrument measure what it purports to measure? Construct validity was tested in two ways: (1) by comparing balance performance on the instrument between young and old subjects (based on the assumption that balance is impaired with aging); and (2) by comparing balance performance in the young subjects with and without visual feedback (based on the assumption that removing visual feedback results in impaired balance). Additionally, the relationship between balance and muscle strength was assessed since both are known to be affected by age.

Methods: A tilt-board commonly used in physical therapy was used for testing balance. It consisted of a block 1.5” wide by 2” high fixed centrally to a rectangular board (17”x15”). The block was slightly beveled at the edges to make it less stable. Each side of the board was instrumented with switches to detect ground contact (occurring with 10° of tilt). Subjects attempted to maintain balance for one minute in double-limb stance (without shoes) with their feet positioned shoulder-width apart and arms folded across the chest. The time during which the switches were activated represented when subjects were out of balance. Therefore, the time in balance was defined as the period during which the switches were inactive. Two groups of subjects were tested: a healthy young group (31 men, 44 women) age 30±7 yr (17-46 yr) and a healthy elderly group (12 men, 32 women) age 74±7 yr (51-88 yr). Young subjects were recruited from a population of health professionals and graduate students, while elderly subjects were recruited at a health fair for seniors. All subjects gave informed consent and the study was approved by the institutional review board. The younger subjects performed a second test during which they were blindfolded to remove visual feedback. Following balance tests, hip flexion and abduction strength were tested with a hand-held dynamometer (Nicholas MMT). Strength measures were converted to torques and corrected for body mass. Age and gender effects on balance and strength were assessed using group (young vs. elderly) by gender (men vs. women) analysis of variance (ANOVA). Within the young group, the effect of visual feedback was assessed with a paired t-test. The relationship between balance and strength within each group was assessed by Pearson product-moment correlations. Means ± SD are provided in the text and figures.

Results: Young subjects were able to maintain balance for 47.6±6.7 s while elderly subjects only maintained balance for 29.6±6.7 s (p<0.0001; Fig.1). When visual feedback was removed (blindfolded) the young group were able to maintain balance for 34.2±4.8 s, but this was still better than balance in the elderly group with visual feedback (p<0.0001; Fig. 1). The elderly subjects were significantly weaker than the young subjects in both hip flexion and abduction (p<0.0001; Fig. 2). Within both groups women were significantly weaker than men (p<0.0001). Balance ability not different between men and women. Within each groups balance was unrelated to strength. Nine of the elderly subjects (3 men, 6 women) reported having had a fall in the last year. Balance and strength measures were not different between these subjects and the rest of the elderly subjects.

Discussion: Marked differences in balance ability were demonstrated between the young and elderly subjects. 95% (71 of 75) of the young subjects were able to maintain balance for more than 35 s compared with only 11% (5 of 44) of the elderly subjects. Removing visual feedback by blindfolding the young subjects reduced in time in balance by 28%. Both effects (aging and blindfolding) demonstrate good construct validity for the instrument. The fact that the balance performance in the young subjects was better than the elderly subjects, even when the young subjects were blindfolded, indicates a profound loss of balance ability in the elderly. Although strength and balance were unrelated within groups, the relative differences in strength and balance between the groups were remarkably similar; in the elderly group balance time was 38% lower, hip flexion strength was 39% lower and hip abduction strength was 37% lower. Since no subjects were able to maintain perfect balance for 60 s, the test was primarily an assessment of ability to reestablish equilibrium. In conclusion, these results indicate that this instrument may provide an inexpensive portable screening tool for assessing balance ability in the elderly.

References:
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