INTRODUCTION

Clinicians use multiple approaches to assess balance impairment. However, these clinical measures are not sensitive to subtle changes in balance. The scientific analysis of balance is an emerging field. Objective measures of balance include posturography and gait analysis. The purpose of this study was to compare the relationship among the various measures of balance impairment.

METHODS

The study consisted of 10 patients (6 men and 4 women ranging in age from 18 to 65 years) who had a traumatic brain injury (TBI) and ten age, gender, and body mass index matched controls. The TBI designation was made on the basis of a documented TBI by physician assessment supported by additional information such as decreased Glasgow Coma Score within 24 hours of injury, documented loss of consciousness and findings on imaging. Subjects were required to be at least 3 months post injury, living in the community, and to have had normal gait and balance prior to their injury. In addition, the patients had to have current complaints of dizziness or unsteadiness when walking. Each subject’s self-perception of disability due to symptoms of dizziness was measured using the Dizziness Handicap Inventory (DHI), a standardized, validated questionnaire (Jacobson and Newman 1990).

Balance impairment was objectively tested using two methods. A sensory organization test (SOT) that assessed the three components of balance (vision, proprioception, and vestibular function) was performed using computerized dynamic posturography (Equitest NeuroCom International Inc., Clackamas, Oregon). A gait study was used to quantify the displacement of the body center of mass (COM). Twenty seven reflective markers were placed on bony landmarks and an eight-camera ExpertVision® System (Motion Analysis Corp., Santa Rosa, California) was used to collect 3-D marker trajectory data. A biomechanical model consisting of 13 body segments (four upper extremity, six lower extremity, and one for the pelvis, trunk, and head) was used to compute the COM displacement.

RESULTS AND DISCUSSION

Based on the initial Glasgow Coma Score (GCS), four subjects had severe TBI (GCS< 9), two had moderate TBI (9= GCS = 12), and four had mild TBI (GCS > 12). Tinetti Balance Assessments were obtained and the TBI group was not significantly different from the normal controls.

The DHI scores supported the subjects’ complaints of “unsteadiness” and “imbalance”. The DHI physical domain score was 10.4 (± 5.3), emotional domain score of 10.2 (± 9.6), functional domain score of 11.6 (±10.7), and total score of 32.2 (± 23.0). The subject’s complaints of “dizziness” or “unsteadiness” were not detected by a clinical examination or the Tinetti balance scale score. However, the DHI indicated that this imbalance had effects on the physical, emotional, and functional aspects of individual’s lives.

The SOT composite score was significantly lower in the TBI subjects (70 ± 12) compared to the normal controls (80 ± 8). Using posturography, four of the patients would be considered to have abnormal balance (SOT<70). There were correlations between the SOT and DHI. However, none of these correlations were statistically significant and all correlations were only moderate to weak. There is controversy regarding the use of posturography as a measure of balance impairment. Some authors have stated that posturography does not predict stability (O’Neill, Gill-Body et al. 1998; Evans and Krebs 1999). In contrast, Furman (Furman 1994) believes that posturography provides an indication of the impact of balance impairment on daily activities.

The displacements of the COM in the anterior and vertical direction were negatively correlated with the components of the DHI, whereas the displacement in the medial/lateral direction was positively correlated. Most importantly, there was a significant correlation of the COM peak velocity in the coronal plane with the physical, functional, and total DHI scores.

SUMMARY

The present study found that posturography test scores do not correlate with the subject’s clinical symptoms. Gait analysis techniques have not been used routinely to assess clinical complaints of imbalance from patients. However, this study has demonstrated that gait analysis can be used to objectively quantify the subjective complaints of unsteadiness reported by patients with balance disorders. Moreover, gait analysis techniques quantify the dynamic aspects of balance impairment which the patient senses.

REFERENCES


