

Abstract

Balance disorders are one of the most common impairments referred by individuals who have suffered a brain injury. Rehabilitation of balance is a key aspect of the neurorehabilitation interventions, because it is associated with an increase in self-dependency. In chronic stages, the mere repetition of movements may be a necessary but not a sufficient condition to sustain functional changes in the motor skills. Interventions based on the motor learning principles, which focus on intensive, repetitive, task-oriented, and adaptive difficulty tasks, have shown to provide clinical benefits to individuals after a brain lesion, even long time after the onset. Virtual reality has been previously proposed to design training programs tailored to the needs of each individual, in a safe and controlled way. However, most of the studies presented to date have focused on the motor skills of the upper limb or on the general mobility. This document describes a set of exercises specifically designed to train the balance strategies, as well as their clinical effectiveness, under different conditions, in the rehabilitation of balance. Similarly, the interaction and assessment tools used in this work are analyzed to ensure their performance and to determine the subjective perceptions derived from their use.

The studies presented here show that the experimental interventions combining virtual reality-based exercises specifically designed to train the balance strategies and conventional physical therapy programs can provide clinical benefits to the balance condition of brain injury population, even in chronic stages. In addition, these interventions can provide benefits over pure physical therapy protocols, and even as a part of telerehabilitation protocols, in which the subjects undergo the training sessions at their own place. The studies also show that the proposed exercises are usable, motivating, and provide good levels of presence and immersion. The in-depth evaluation of the interaction tools provides evidence that the needs and perceptions of patients and physical therapists are different and must be taken into account, besides their performance, to integrate these systems in the clinical setting, but also in telerehabilitation protocols, which can reduce, under some circumstances, the costs associated to the neurorehabilitation programs.