

## VIRTUAL REALITY EXERCISE PROTOCOLS IN NEUROLOGY

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The virtual reality (VR) have had a strong expansion in the physical rehabilitation area. In the last 10 years, the VR interfaces protocols have been used for treating neurological patients. One of the widely used VR devices is the Nintendo Wii because is of low cost and also easily usable to the therapists. In line with this, and considering that neurological rehabilitation programs should be transferable to patients for their constant repetition at home, is interesting to know the advantages, uses (assessment and intervention) and plausible mechanisms to explain its effects in the rehabilitation of this patients.

### **Advantages of virtual reality interface: Nintendo Wii device**

VR produces an artificial environment of multisensory interaction (vision, vestibular, somatosensory and auditory) created by software. Interaction and immersion are two key characteristics of VR. The use of VR interface devices has been amply reported in medicine and rehabilitation<sup>1</sup>. Head mounted display, joystick, wired gloves and a video game console

are all VR interface devices. However, Nintendo Wii offer a relative low-cost, accessible and highly transferable option to neurological patients and neurological care centers to perform rehabilitation interventions. Nintendo Wii exercise program have contributed mainly with the postural control which is dependent on sensory feedback provided by the visual, vestibular and sensory systems (mechanoreceptors and proprioceptors). In line with this, children and adolescents show clear signs of postural balance that depend on the age, process associated with the neural maturity reached between 15-16 years of age<sup>1</sup>. At this age, individuals present a well calibrated postural control. This is a fundamental reason to impart postural control rehabilitation programs during childhood or adolescence, period in which the Central Nervous System present higher adaptability and modulation to environmental sensory stimulation. Nintendo Wii has been proposed as a training tool to improve postural control (i.e., balance) and/or motor recovery in cerebral palsy, post stroke and with Parkinson's disease<sup>2-4</sup>.

## **VR interface in the assessment of the postural control**

Assessments of postural control is critical for determining the aims in the rehabilitation of the patients with impaired of postural stability. Postural control is usually assessed with a laboratory equipment, the force plate. It provides parameters of the center of pressure (COP) which represent stability and postural balance.

Ballaz and colleagues (2014) proposed a new method to asses' dynamic postural control for children with spastic diplegic cerebral palsy. They using of Wii Balance Board (WBB) to assess visually guided mediolateral (ML) weight shifting ability. In this case, the balance board was placing on force plate to measurement the displacement of the COP and to know the postural control of the patients<sup>5</sup>. As well as, this device has been utilized as a tool for the assessment of balance and postural stability following stroke, Multiple Sclerosis patients and older adults and inclusive the Wii Fit Game may specifically provide reliable and valid measurements for predicting fall risk<sup>6-8</sup>. However, long before its reliability was tested with its laboratory counterpart, the force platform. Moreover, the Xbox Kinect, it has also been considered as tools to obtain reliable and valid COP measurements<sup>9</sup>.

## **Mechanisms that explain the effects of VR games protocols**

Improvement in the standing balance, postural control and reduction of spasticity in clinical populations as post-stroke, Parkinson's disease and cerebral palsy are some of the effects VR interfaces when are used through of duly tested protocols<sup>2</sup>. The mechanisms that account for these effects point to the environments that VR creates. VR provide abundant multisensory stimuli using online feedback on gaming performance (visual, vestibular proprioceptive, and auditory). For example, visual feedback has been postulated to improve balance as well as are generated weight-shifting strategies in order to move interactive elements (i.e., avatars) promoting the massive activation of proprioceptors in the different joints of the body. Therefore, VR games protocols generate visual feedback, which elicits not

only reactive but also proactive balance responses, such as weight shifting, to accomplish a task.

Within the physiological foundations that explain the effects of VR games protocols are the repetition, sensory feedback and motivation. Repetition, is the basis of brain plasticity. Neural activation is based on the existence of mirror neurons that were stimulated by observation of the execution of analogous tasks by other people in a mirror-like effect created by virtual environments. Sensory feedback occurs by multisensory environments generated during VR games protocols, for example proprioceptive, visual, vestibular and auditory systems are activated in the performance, where three of them are directly associated with the control of postural control (indicate above). In this sense, Nintendo Wii exercise program trains the postural balance in a sequence of exercises in three planes of motion: sagittal, frontal and transverse generating a massive activation of proprioceptors in the body<sup>2</sup>. Finally, the motivation is achieved through various attractive and interesting exercises introduced intrinsically by the VR game, these can elicit multisensory interactions that motivate and engage the patient in each sessions.

### **Scientific implication of virtual reality**

VR is an effective technological tool to treat neurological disorders. To achieve these effects, use protocols must be generated and the appropriate dose determined. VR games protocols improves postural control in children with cerebral palsy, and reduced spasticity in this populations and post stroke. Therefore, its use is recommended to improve the postural control, as well as for assessments in these patients.

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