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Intensive Upper Limb Neurorehabilitation with Virtual Reality in Chronic Stroke: A Case Report

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Upper limb motor deficits are a frequent consequence of stroke, limiting patients in their daily life activities. The recovery process is slow and long, including several months or even years of rehabilitation, with the risk of diminishing patient motivation and involvement. Intensive therapy has been shown beneficial, improving the speed of recovery and the degree of independence. In this context, virtual reality (VR) based motor rehabilitation systems provide a potential complement to current therapy in order to intensify the therapy dose and to maintain patients motivation. This study was aimed at evaluating the rehabilitation dose and effect of a VR-based system (MindMotionPRO, MindMaze SA) that enables intensive training adapted to impaired upper limb motor skills in a game-like scenario. The interactive exercises engaged patient's shoulder, elbow and wrist movements with various levels of difficulty. The system provides real-time feedback of patient's performance, with an avatar reproducing his movements on the screen while performing different motor tasks (pointing, reaching, grasping).

A 50-year-old right-handed man, who had a left ischemic stroke 26 months earlier, was recruited for this study. He discontinued the conventional physiotherapy (once per week) in January 2015. At the time of recruitment (NIHSS=3), deficits in his right upper limb were notable in coordinating arm movements, with a Fugl-Meyer Assessment Upper Extremity (FMA-UE) score of 47/66 (Reflexes=4/4; Flexor synergy=9/12; Extensor synergy=5/6; Movement combining synergy=4/6; Movement out of synergy=5/6; Wrist=9/10; Hand=7/14; Coordination/Speed-Finger=4/6). One-hour sessions of intensive VR-based therapy were administered twice per week for five consecutive weeks (10 sessions in total) at the *Clinique Romande de Réadaptation* (Sion, Switzerland), starting on 21 April 2015. On average, the patient performed 804 goal-directed movements per session with his affected limb. Interestingly, the therapy dose continuously increased from 519 (session 1) to 809 (session 10) repetitions per day. In complement to the training, the patient engaged in daily sport activities. Post-treatment assessments showed an increase of 7 points in FMA-UE score (54/66), with improvements in proximal upper limb control and arm coordination (Flexor synergy=10/12; Extensor synergy=6/6; Movement combining synergy=6/6; Hand=9/14; Coordination/Speed-Finger=5/6). Moreover, the patient reported a positive experience with the technology and showed high levels of engagement during the sessions.

Based on this case report, we surmise that the use of the MindMotionPRO in clinical settings increases the feasibility of adjusting the rehabilitation dose upwards to speed up the recovery. The patient received one-hour intensive VR-based therapy twice a week in addition to sport activities, which contributed to an improvement in his motor outcomes. Intensive VR-based therapy brings thus promising perspectives for maximizing the efficacy of motor rehabilitation in stroke patients.