Abstract for the International Conference on Virtual Rehabilitation (ICVR 2013), Philadelphia, PA

Development and Evaluation of a Tele-Health System for Upper Extremity Stroke Rehabilitation

R Kizony, S Harel P L Weiss, Y Feldman, M Shani

The goal of tele-rehabilitation is to improve patient access to care by providing therapy beyond the physical walls of a traditional healthcare facility. This serves to expand continuity of care to persons with disabling conditions as well as provides the potential for receiving care at a lower cost and for a longer duration. Moreover, research in neuroscience and especially brain plasticity emphasizes the need for intense treatment and rehabilitation following the acute phase and continuing when the person returns home. ReAbility (web site) is a video-capture VR system designed to provide a home-based tele-rehabilitation program to improve the upper extremity motor and overall functional status of people who have neurological dysfunction such as stroke. The goal of this study was to evaluate ReAbility's clinical effectiveness in improving outcomes of active movements and functional performance of the weak upper extremity compared to home-based self-instruction exercises.

This study was a single site, 2-arm, single-blinded Randomized Control Trial. After exclusions related to ineligibility to participate (less than 2 or more than 72 months post stroke; less than 45 degrees of shoulder flexion or abduction range of motion), 20 participants were randomized into two groups; one participant withdrew from the control group shortly after he started the study's protocol. In this report only 18 subjects (9 from each group), all more than 6 months post stroke who completed all testing including follow-up, were analyzed. *The Gertner Tele-Motion-Rehab (TMR) system* set-up, presented in greater detail by Weiss et al. (2012) includes interaction between the client (currently in an on-site hospital-based room that simulates the person's home, Fig. 2, left) and the hospital-based clinician. We use a 3D video capture camera based system (Kinect camera and Microsoft Kinect Software Developer's Kit (SDK), version 1.5) in which the client's upper extremity and trunk motions control the action of customized video games.

The five video games/tasks used during the study intervention (Puzzle, Memory, Pizza/Hamburger, Arrows, Tasks) were described in our previous report which demonstrated that the TMR has moderate to good accuracy and excellent usability. They differ in the type of motion required by the client as well as in their level of motor and cognitive difficulty but all require that the client make 3D reaching motions of the upper extremities to complete the tasks while avoiding compensatory shoulder, elbow and trunk motions. Each participant in this group received a list of exercises to be performed at home using a stand-alone poster as targets for the movements. The movement requirements were similar to those of the experimental group. On-site instruction was provided to ensure that movements were at the appropriate level of difficulty. In addition, each subject was asked to write the dates and duration of time that the exercises were performed. They returned to the clinic for re-evaluation and adjustment of the self-training exercises after every four sessions.

Following randomization, the participants were evaluated with the outcome measures listed above as well as with the TMR system evaluation protocol and demo setting over two sessions on different days for a total of 5-6 hours (pre-intervention evaluation). The control group was asked to perform structured, upper extremity self-training exercises for the same duration and frequency as the research group. In order to achieve consistency in the target exercises, each participant in the control group was instructed individually to perform the exercises as displayed on the large poster board. Compliance of the control group was done via phone and meetings with the therapist in the hospitals were carried out at the first, fourth, ninth and twelfth sessions for similar purposes as described for the research group. The same outcome measures were used to assess the participants in both groups within one week of their completion of the intervention (post-intervention evaluation) as well as after one month (follow-up evaluation).

Results of the MAL Intensity found significant differences between all measures was found only within the research group (Research; χ^2=12.3, p=.002; Control; χ^2=2.8, p=.25). Further analysis with Wilcoxon signed rank test within the research group showed significant difference with large effect size between the first and second assessments (z=-2.521, p=.012, r=0.84). Results of the MAL Quality are presented in Figure 6. Significant differences between all measures was found only within the research group (Research; χ^2=15.5, p=.0001; Control; χ^2=0.9, p=.64). Further analysis with Wilcoxon signed rank test within the research group showed significant difference with large effect size between the first and second assessments (z=-2.524, p=.012, r=0.84) as well as between the second and third assessment (z=-2.366, p=.018, r=0.79).

Although the results of the current study need to be interpreted cautiously due to the small sample size, they point to the potential of using the Gertner Tele Motion Rehab system to improve the functional use of the upper extremity post-stroke in a quasi-home set up. Although intervention was not provided at home it followed the same procedures as home-based therapy regarding the therapist role in treatment and thus provide support for the next stage of implementing an actual home-based tele-rehabilitation protocol with the Gertner System.