AWARD

THE EUROPEAN ACADEMY OF REHABILITATION MEDICINE SCIENTIFIC PRIZE 2014
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WINNER 2014: MANOJ SIVAN

Summary of research: A home-based Computer Assisted Arm Rehabilitation (hCAAR) device for upper limb exercises in stroke. This thesis was awarded the European Academy of Rehabilitation Medicine prize 2014. Dr Sivan received his prize during the congress of Baltic and North Sea Forum on PRM in Riga, September 2015.

Home-based robotic technologies may offer the possibility of self-directed upper limb exercise after stroke as a means of increasing the intensity of rehabilitation therapy. The current literature has a paucity of robotic devices that have been tested in a home environment. The aim of this research project was to develop and evaluate a robotic device (hCAAR) that can be used independently at home by stroke survivors with upper limb weakness. The project had two stages: Stage 1, hCAAR development using a user-centred design process; Stage 2, a feasibility clinical study in the home setting.

Stage 1: Nine stroke survivors with upper limb weakness and 6 healthcare professionals were involved in the concept and design stages of device development. hCAAR consists of a powered joystick with a computer interface, which is used to direct the movement of the upper limb to perform therapeutic movements as directed by tasks on the screen. hCAAR also provides controlled assistance when the user's voluntary upper limb movement is insufficient to complete the prescribed task.

Stage 2: In the feasibility study, 19 participants (stroke survivors with upper limb weakness) were recruited. Clinical outcomes performed at baseline (A0), at end of 8-weeks of hCAAR use (A1) and one month after end of hCAAR use (A2) were: Optotrak kinematic variables, Fugl Meyer Upper Extremity motor subscale (FM-UE), Action Research Arm Test (ARAT), Medical Research Council (MRC) muscle strength scale and Modified Ashworth Scale (MAS), Chedoke Arm and Hand Activity Inventory (CAHAI), ABILHAND and participant/carer/therapist qualitative feedback.

No serious adverse events were reported. Two participants were unable to use hCAAR: one due to severe paresis (FM 6/66); and the other due to personal problems. The remaining 17 participants were able to use the device independently in their home setting. The median usage time was 433 min (IQR 250–791 min). A statistically significant improvement was observed in the kinematic and clinical outcomes at A1. The median gain in the scores at A1 were by: movement time 19%, path length 15% and jerk 19%, FM-UE 1 point, total MAS 1.5 point, total MRC 2 points, ARAT 3 points, CAHAI 5.5 points and ABILHAND 3 points. Three participants showed clinically significant improvement in all the clinical outcomes. Five participants reported improvement in functional ability in daily activities. Participants, family members and therapists were satisfied with the usability of hCAAR in the home setting. The research project also demonstrated that the Comprehensive International Classification of Functioning, Disability and Health (ICF) Core Set for stroke provides a useful basis to structure interviews to gather feedback from end-users and healthcare professionals in different stages (concept, design and testing) of the rehabilitation device development.

In conclusion, a home-based restorative rehabilitation robotic device has been developed using a user-centred design process that involved stroke survivors and healthcare professionals. The hCAAR feasibility study is the first clinical study of its kind reported in the current literature; in this study, 17 participants used the robotic device independently for 8 weeks in their own homes with minimal supervision from healthcare professionals. Statistically significant improvements were observed in the kinematic and clinical outcomes in the study.

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References

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Professor M. Anne Chamberlain congratulating Manoj Sivan for receiving the European Academy Award 2014 at the BNFPRM congress in Riga.