Tech-driven Exergaming to Support Therapeutic Activity Targeting Upper Extremity Function in Persons with Stroke a Mixed Methods Case Series

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INTRODUCTION

Despite advances in treatment, long term disability following stroke persists. At 6 months post stroke approximately 65% of people with stroke have hand and arm impairments that limit their ability to perform activities of daily living. Despite evidence that rehabilitative therapies lessen disability after stroke, less than a third of persons with chronic stroke receive long-term outpatient therapies [1]. Access to long term therapies is limited by a combination of reimbursement challenges and geographic / transportation issues. Telerehabilitation has been cited as an option that could address these issues. Poor adherence to independent exercise is another factor that limits the effectiveness of post stroke rehabilitation. Exergaming based rehabilitation is associated with higher levels of independent exercise adherence than traditionally presented activities. This poster presents describes response to a two week exergame based telerehabilitation intervention demonstrated by four persons with chronic stroke.

PARTICIPANTS

Participants were recruited from a registry of people with stroke. All participants completed an informed consent process approved by Kessler Foundation. See Table 1 for participant demographics.

Table 1: Participant Demographics

ID	Age	Gender	Initial UEFMA	Years Since CVA	Number HEP Sessions	Total Training Time (minutes)
S1	68	M	44	8	8	197
S2	55	F	61	2	8	301
S3	68	F	57	4	12	383
S4	60	M	40	2	23	424

METHODS

During the first in person session subjects completed pre and post testing which included the Upper Extremity Fugyl-Meyer Assessment, Action Research Arm Test, and Box and Blocks Test as well as a battery of active range of motion and kinematic tests administered using the R3THA system. In a second in-person visit (60 minutes), stroke participants were oriented on how to use R3THA, and their therapist oriented them to an independent exercise program that included 30 minutes of R3THA-based exercises tailored to address their specific movement impairments and goals, that they were instructed to perform daily at home. Participants were also provided the hardware and software to use at home and taught how to use it. Participants completed 5 additional on-line sessions, supervised by their study therapist. These sessions focused on reviewing independent R3THA training performance, fine tuning exercise form, adjusting the difficulty levels of the R3THA games and substituting more challenging games when basic games were mastered. Participants performed all the testing and answered semi-structured interview questions after completing the rehabilitation intervention.

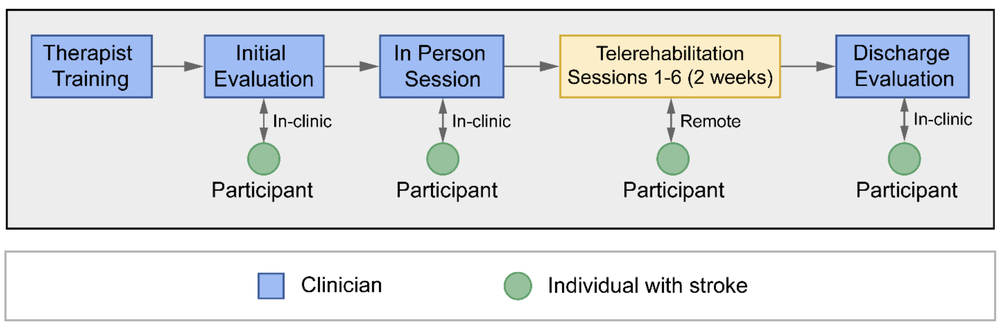


Figure 1: Intervention protocol

RESULTS

All four participants completed the protocol without significant adverse events. All participants completed 100% of the scheduled telerehabilitation sessions with their therapist. The number of independent sessions and time spent during independent activity varied (see Table 1). Motor function varied across participants. S1 demonstrated improvements in hand opening and wrist AROM as well as wrist movement accuracy. S3 demonstrated improvements in hand movement accuracy and S4 in wrist movement accuracy. S4 demonstrated improvement in BBT that exceeds the published MCID, S3 demonstrated improvement in the ARAT that exceeds the published MCID (See Table 2).

Table 2: Motor Function Improvements.

ID	Hand Opening mm		Wrist ROM (deg)		Hand Accuracy %		Wrist Accuracy %		BBT		ARAT	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
S1	5	57	63	65	60	71	79	87	14	13	32	27
S2	56	57	62	97	73	74	86	85	22	23	44	44
S3	48	48	85	82	82	90	90	94	14	18	30	41
S4	9	7	64	67	68	71	82	75	45	54	53	57

RESULTS (CONT'D)

Table 3: Usability

ID	Positive Impressions	Negative Impressions
S1	• Expressed a strong ability to follow the game interface and directions. • Felt the system was well-organized and easy to use, stating that everything was 'lined up' and it was clear what needed to be done. • The feedback from the games, such as in 'Dog Dash,' helped them understand the exercises. • Appreciated the clear instructions and felt it was enough to guide them through the games.	• The participant had to adapt to using a computer for the game, which was different from using more familiar touch devices like an iPad. • The games occasionally froze or crashed, interrupting the therapy sessions.
S2	• Their familiarity with technology helped them navigate the system, despite some challenges with obtaining results. • Found the video guidance helpful.	• Had some difficulties with understanding certain instructions, such as pronation and supination. • Described some technical issues with the camera not picking up movements accurately.
S3	• Found the games challenging and beneficial for concentration and motivation. • Appreciated the design of the progress reports and found the system motivating to use at home.	• Experienced difficulties with the camera being slow to sense movements, which impacted their gameplay. • Felt very tired, especially in the arm and shoulder, after playing the games.
S4	• Found the games engaging due to the multiple levels and appreciated the challenge they provided. • Found the games beneficial as exercises.	• Experienced occasional game crashes during sessions and some camera-related problems. • Had trouble hearing certain aspects of the game, which was not resolved by adjusting the volume.

Table 4: Feedback and Motivation

ID	Positive Impressions
S1	• The participant appreciated the game's interface and feedback, which guided them through the exercises effectively. • Participant motivation stemmed from seeing improvement in hand function after stroke.
S2	• Found the games more interesting than regular therapy, as they involved engaging activities. • The games provided a fun and motivational alternative to traditional therapy tasks, and they expressed interest in using the system at home to improve further.
S3	• Was motivated to use the game for physical therapy primarily to improve their condition and achieve high scores. • They found the games challenging, which helped them focus and concentrate, ultimately motivating them to get better. • Interest in the game and the motivation to improve were significant reasons for continuing to use the system.
S4	• The progress reports discussed with their therapist helped them recognize areas of improvement and motivated them to continue using the system to get better. • Was motivated by the progression through game levels, which maintained their interest and provided a sense of accomplishment.

DISCUSSION / CONCLUSION

The participants' experiences using the R3THA system in the context of a telerehabilitation intervention point to the feasibility and usability of this approach as an alternative to in-person rehabilitation for the hand and arm in people with chronic stroke. Three of the four participants demonstrated motor function improvements with two making clinically important improvements. This is notable in a shorter study, with participants in the chronic stage. Better adherence might have had a positive impact on motor function changes. All of the participants experienced challenges related to the technology. This said each one could point to aspects of the gaming system that enhanced the rehabilitation experience.

REFERENCES

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