Feasibility of Integrating a Technology-based Exergaming System Designed to Rehabilitate the Upper Extremity of Persons with CNS Pathologies into a 4-week Clinic-based, Small Group, Intensive Therapy Program for Children with Cerebral Palsy

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INTRODUCTION

Intensive therapeutic programs have been utilized in children with upper extremity impairments due to cerebral palsy for over a decade [1,2]. Long term retention of gains achieved during these interventions and approaches to optimizing retention is an area receiving increasing attention [3,4]. Camp Helping Hands is a program that uses a small group-based approach, which provides activity-based therapy tailored to each participant's personal goals, focused on improving hand and arm function through therapeutic activities. Activities include arts and crafts, sports, games, and hands-on exercises. CIMT is incorporated into the plans of care of all participants as well as other bilateral goal-oriented activities. In summer 2024 we investigated the feasibility of integrating R3THA, an exergaming system designed to address upper extremity motor dysfunction experienced by adults and children with central nervous system dysfunction [5] to supplement traditionally presented camp activities with an eye toward working on activities that could be performed by children at home after the intensive intervention period has passed. This poster will present this initial feasibility testing outcomes which will include clinical performance with the exergaming intervention, overall response to the camp intervention, as well the participants' and therapists' impressions of the exergaming system.

SUBJECTS

Table 1: Subjects Demographic

ID	1	2	3	4	5	6	7	8	9	10	11	12	13
R/L affected	R	L	L	R	L	L	R	L	R	L	L	R	R
Age	9	10	14	12	13	9	9	17	16	10	10	16	14
Sex	M	M	F	M	M	M	F	M	M	F	M	M	M
MACS	IV	III	II	IV	IV	IV	II	III	IV	III	II	III	II

METHODS

R3THA is a camera based system with 15 games that address shoulder, elbow, forearm wrist and finger movements in isolation along with 3 games that require coordinated movement of several joints (See Figure 1 for photos of children playing R3THA games).

To prepare for this, a one-hour training session was conducted with all members of the camp staff. 13 participants with unilateral cerebral palsy (MACS levels II – IV) (Eliasson 2006) used the exergaming system as part of their camp activity. Rehabilitation plans, tailored to each child's COPM goals, included assigned exergames and specified play durations. A designated OT operated the system according to these plans. The first session using R3THA required a five to ten-minute calibration session. R3THA measures hand opening aperture, range of motion for one forearm and two wrist movements and three-dimensional reaching workspace .

Participants were scheduled to play the exergames 2-3 times per week for a total of 11 sessions. Each exergaming session lasted about 15 minutes, followed by an additional 5 minutes for free play.

The Box and Block Test (BBT) [6], Melbourne Assessment II (MA2) [7] were used to measure outcomes at the body structure/function level. The Canadian Outcome Performance Measures (COPM) / Goal Attainment Scaling (GAS) were used to evaluate participant's progress on individualized rehabilitation goals [8].

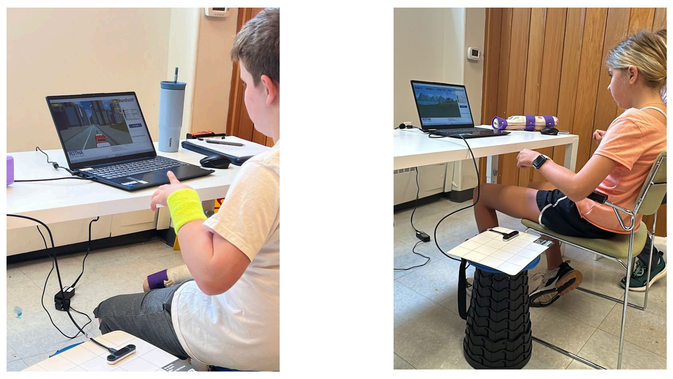


Figure 1: Children playing R3THA games at camp

RESULTS

Exergaming time on task averaged 7 minutes per 20-minute session and 17 minutes per week for the thirteen participants. This represents approximately 34% time on task (See Figure 2). Time on task was weakly correlated to age in years (r = -.261 p> .05) or impairment level as measured by MACS (r= .012 p>.05).

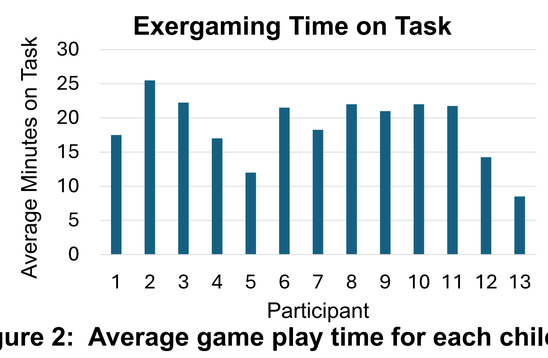


Figure 2: Average game play time for each child

RESULTS (CONT'D)

BBT: Improvements ranged between 1 and 14 blocks. Median improvement was 4 blocks. Three participants demonstrated improvements that exceed the published MCID of 5 blocks [9].

MA2: The score change range and median values for MA2 are listed in Table 2.

Table 1: Melbourne Assessment 2 (MA2) score change

Melbourne Assessment 2	Range of Motion	Accuracy	Dexterity	Fluency
Number of Participants Demonstrating Improvement	8	8	5	2
Range	3.7 – 18.5	4.0 – 36.1	6.25 – 18.75	4.76 – 9.5
Median	9.3	16	12.5	7.14
Number exceeding MCID [10]	8	8	5	2

COPM/GAS: Twelve of the thirteen participants set between two and five goals. Average GAS achievement scores ranged between 0 and 1.5. Mean achievement score was .91 (SD=0.45). All but one of the 13 participants scored a one or better on at least one of the goals they set for camp. Twelve of the goals set by participants involved gross motor or stabilizing hand behaviors. GAS achievement score frequencies for these goals were two (1 participant), one (6 participants), zero (5 participants) and negative one (1 participant). Nineteen of the goals set by participants involved fine motor behaviors. GAS achievement score frequencies for these goals were two (4participants), one (12 participants), zero (2 participants) and negative one (2 participants). Thematic analysis of observers' transcripts suggested that ten of the 13 participants enjoyed the exergaming sessions (see Table 2).

Table 2: children's positive feedback

ID	Feedback
2	Enjoyed R3THA, which kept him motivated each day, although he sometimes became frustrated if he did not perform as well as expected.
3	Body language and willingness to participate indicated she enjoyed it, even though she did not often comment on her experience. Talked about his interest in R3THA on days he did not have it, indicating he found it engaging.
4	Body language suggested he enjoyed R3THA despite not commenting directly.
6	Appeared eager to go to R3THA when it was his turn, indicating enjoyment.
7	Looked forward to participating in R3THA games, showing clear enjoyment.
8	Appeared to enjoy R3THA, as he was eager to participate.
9	Seemed to enjoy R3THA, as he was eager to go when it was his turn.
10	Smiled during transitions to and from R3THA, suggesting she enjoyed it.
12	Stated he enjoyed it.

DISCUSSION / CONCLUSION

11 periods of exergaming were successfully executed within the intensive intervention without adverse events. Time on task for the exergaming sessions was consistent with clinical productivity. The lack of correlation between impairment level or age and training time suggests that the exergaming intervention was equally suited to children and teenagers with moderate to mild impairments. Overall motor outcomes for the camp were excellent with all thirteen of the participants demonstrating clinically meaningful improvements in upper function as measured by the COPM. This cohort seemed to make greater gains in fine motor function than gross motor function, but this observation would need to be examined with a purpose-designed clinical trial to make a definitive conclusion. Participants demonstrated enjoyment related to the use of the exergaming system. Refinement of the exergaming system and its use in clinic will be necessary before broad-based adoption will be achieved. Further testing of children using the system in a home-based setting is indicated.



REFERENCES

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