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The Effect of Playstation 2-Eye Toy Play on Upper Extremity Motor Functions and Functional Independence in Children with Hemiparetic Cerebral Palsy: A Comparative Study

Hemiparetik Serebral Palsili Çocuklarda Playstation 2-Eye Toy Play'in Üst Ekstremite Motor Fonksiyonları ve Fonksiyonel Bağımsızlık Üzerine Etkisi: Karşılaştırmalı Bir Çalışma

Bilge BAŞAKÇI ÇALIK[1], Uğur GÜLEÇ[2], Sebahat Yaprak ÇETİN[3], Erdoğan KAVLAK[1]

[1]Pamukkale University, Faculty of Physiotherapy and Rehabilitation, Denizli, Turkey
[2]Gezginler Special Training and Rehabilitation Center, Ankara, Turkey
[3]Akdeniz University Faculty of Health Sciences, Department of Physiotherapy and Rehabilitation, Antalya, Turkey

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ABSTRACT

Objective: The aim of this study was to investigate the effect of Playstation 2-Eye Toy Play on upper extremity motor functions and functional independence in children with hemiparetic cerebral palsy.

Methods: The study included 30 children with hemiparetic cerebral palsy with an average age of 9.8±2.3 years. Children were randomly assigned to the two groups. Group 1 received traditional therapy and Playstation 2-Eye Toy Play, and group 2 received only traditional therapy for 2 days a week. Bruininks-Oseretsky Test of Motor Proficiency Short Form (BOT2-SF), Fugl-Meyer Motor Function Assessment (FMA), and Pediatric Functional Independence Measure (Wee-FIM) were used for the evaluation of both groups before and after the training.

Results: There was a statistically significant difference in the FMA (all sub-parameters and total score), Wee-FIM (self-care, locomotion, communication and total score) and BOT2-SF (all score) after training compared to before in the group 1 (p=0.00-0.02). In the group 2, it was found that the difference in FMA (hand, coordination and total score) and Wee-FIM (self-care, transfer, locomotion, and total score) were statistically significant (p=0.00-0.02). When the results between the groups were compared after training, it was found that the increase in only manual coordination and speed measurements of FMA was statistically significant in favor of the group 1 (p=0.00 and 0.01).

Conclusion: because of this study, it is concluded that virtual reality applications performed in addition to conventional training have a positive effect, especially on coordination and speed with manual functions in children with hemiparetic cerebral palsy.

Keywords: Playstation 2-Eye Toy Play, hemiparetic cerebral palsy, upper extremity

ÖZ

Amaç: Bu çalışmanın amacı Playstation 2-Eye Toy Play'in hemiparetik serebral palsili çocuklarda üst ekstremite motor fonksiyonları üzerine etkisini araştırmaktır.

Yöntem: Çalışmaya yaş ortalaması 9,8±2,3 yıl olan hemiparatik serebral palsili 30 çocuk dahil edildi. Çocuklar rastgele iki gruba ayrıldı. Grup 1'e geleneksel terapi ve Playstation 2-Eye Toy Play ve grup 2'ye ise haftada iki gün sadece geleneksel terapi uygulandı. Eğitimden önce ve sonra her iki grubun değerlendirilmesinde Bruininks-Oseretsky Motor Yeterlilik Kısa Formu (BOT2-KF), Fugl-Meyer Motor Fonksiyon Değerlendirmesi (FMD) ve Pediatrik Fonksiyonel Bağımsızlık Ölçeği (PFBÖ) kullanıldı.

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Corresponding Author/ Sorumlu Yazar:
Sebahat Yaprak ÇETİN MD,
Akdeniz University Faculty of Health Sciences, Department of Physiotherapy and Rehabilitation, Antalya, Turkey
Phone: +90 543 633 80 30
✉ fzt.ycetin@gmail.com
ORCID: 0000-0002-7467-1398

Bulgular: Eğitim sonrası grup 1'de FMD (tüm alt parametreler ve toplam puan), PFBÖ (öz bakım, lokomosyon, iletişim ve toplam puan) ve BOT2-KF'de anlamlı farklılık bulundu (p=0,00-0,02). Grup 2'de ise eğitim sonrası FMD (el, koordinasyon ve toplam puan) ile PFBÖ (öz bakım, transfer, lokomosyon ve toplam puan) arasındaki farkın istatistiksel olarak anlamlı olduğu bulundu (p=0,00-0,02). Eğitim sonrası gruplar arası sonuçlar karşılaştırıldığında ise FMD'nin sadece manuel koordinasyon ve hız ölçümlerindeki artışın grup 1 lehine istatistiksel olarak anlamlı olduğu görüldü (p=0,00 ve 0,01).

Sonuç: Bu çalışmanın sonucunda, geleneksel eğitime ek olarak yapılan sanal gerçeklik uygulamalarının hemiparetik serebral palsili çocuklarda özellikle koordinasyon ve manuel fonksiyonları üzerinde olumlu bir etkisi olduğu sonucuna varıldı.

Anahtar Kelimeler: Playstation 2-Eye Toy Play, hemiparetik serebral palsi, üst ekstremite

INTRODUCTION

Cerebral palsy (CP) is defined as a persistent disorder that is seen in the developing brain of a fetus or infant, is non-progressive, restricts activity, and affects motor movement along with posture development.[1] Hemiparesis is one of a spastic clinical types of CP, and the ipsilateral upper and lower extremities are affected. Upper extremity involvement is generally more severe. Difficulties in activities such as gripping, reaching, and manipulating objects arise because of upper extremity involvement.[1,2]

The literature stated that the prevalence estimates of CP range from approximately 1.5 to more than 4 per 1000 live births, and the overall birth prevalence of CP is approximately 2 per 1000 live births.[3] CP rehabilitation is aimed at functioning, motion, and using the child's potential at an optimal level. Treatment approaches such as neurodevelopmental treatment (Bobath), strength training programs, sensory-motor integration therapy, constraint-induced movement therapy are commonly used for motor functions affected in CP.[4] Additionally, the use of technological products such as robot-assisted therapy and virtual reality (VR) in the field of rehabilitation has become widespread. "Virtual Reality", which enables working with task-oriented techniques in a dynamic environment created by computers, is among these applications.[5-8]

VR is a computer-based simulation environment consisting of real-time, interactive, multi-sensory inputs. VR typically includes hardware and software components. Users can use an interface to enter a virtual environment. The concept of VR can be described briefly as "rebuilding the reality". Burdea[5] define VR as "a simulation created using computer graphics to create a realistic-looking world". Moreover, the virtual world is not static, it responds to the user's input (gesture, verbal command, etc.). This real-time interaction describes an essential feature of VR. VR-based therapy makes the user's therapeutic goals a meaningfull experience with their hardware, software, and task-oriented features. Nintendo Wii and Playstation 2, which are the most frequently used game consoles for this therapy, help provide motor training.[9] VR offers many exciting possibilities for the repetitive movement and practice required in pediatric rehabilitation.[5]

The clinical decision to incorporate the use of VR into general rehabilitation practices has been reported to be an experimentally proven and comparable benefit over other methods.[10] This method is currently used in upper extremity rehabilitation, lower extremity training, balance, and gait training areas. VR applications are usually used in adult (approximately 45 years and older) rehabilitation, mostly with traumatic brain injury, and research has been clustered there.[11,12] In studies with adults, it has been shown that an exercise program applied in a virtual environment can improve upper extremity functions and that there is a need for further studies with larger populations and controlled experiments.[13,14] The effect of VR training in children with CP was investigated on balance and gait, and there were few studies on upper extremity functions and functional independence.[14-21] In the literature, Playstation 2-Eye Toy Play effects have been investigated in stroke, individuals with mental and developmental disability, and children with CP as a pilot study.[19,20] This's why we preferred Playstation 2-Eye Toy Play in our study because it is less costly and easy to install. This study was planned because there are insufficient studies in the literature on Eye-Toy Play 2 intervention in CP and to the best our knowledge, there are no studies to examine especially upper extremity functions after this intervention with assessing Fugl-Meyer. The aim of our study aimed to investigate the effects of Playstation 2-Eye Toy Play on upper extremity motor functions and functional independence in children with hemiparetic CP (HCP) and compare it with traditional therapy.

METHODS

Objective and Design

In this randomized controlled parallel group study, the effects of Playstation 2-Eye Toy Play in children with CP were compared with the neurodevelopmental treatment group.

Participants

Children with HCP (n=30) (11 girls, 19 boys) were included and completed the study between the age of 7-14 years. All the cases consisted of children who attended rehabilitation at a center of special education and rehabilitation and received traditional therapy for 2 days in a week. The health board reports that the children with HCP received from the government or university hospitals and submitted to the center were taken into consideration for diagnosis. Children were randomly assigned to two groups [Group 1 traditional therapy + Playstation 2-Eye Toy Play (2 days/week-1 hour per session, n=15, average age: 10.20±2.30 years)] and control group [Group 2 (traditional therapy) n=15, average age: 9.40±2.38 years]. All children included in the study completed the study. The demographic data are shown in Table 1.

The inclusion criteria for enrollment in the study were as follows:

- Being between the ages of 7 and 14,
- To have a mild to-moderate HCP diagnosis according to the Gross Motor Function Classification System (GMFCS),
- Level 1-3 according to the GMFCS.

The exclusion criteria for exclusion from the study were as follows:

- Presence of another chronic illness affecting the existing clinical condition,
- The presence of visual, hearing, and/or mental disability besides to the existing disability.

Procedure

The groups were randomly divided into 2 groups according to age and body mass index values using the Statistical Package for the Social Sciences (SPSS) 16 program by an independent statistician. The allocation procedure was carried out with a random list determined by the statistician who did not know about the study. Group 1 received traditional therapy and Playstation 2-Eye Toy Play, and group 2 received only traditional therapy for 2 days a week. The evaluations were performed by the same physiotherapist twice before and after the training. Bruininks-Oseretsky Test of Motor Proficiency Short Form (BOT2-SF), Fugl-Meyer Motor Function Assessment (FMA), and Pediatric Functional Independence Measure (Wee-FIM) were used for the evaluation of both groups before and after the training.

Table 1. Demographics of children with cerebral palsy

	Traditional therapy group $\bar{x}$±SD	Playstation Eye-Toy 2 group $\bar{x}$±SD	p
Age (years)	9.40±2.38	10.20±2.30	0.365
Gender (n)	3 girls, 12 boys	8 girls, 7 boys	0.063
Weight (kg)	33.31±12.47	34.65±17.09	0.950
Height (cm)	129.67±13.63	131.47±14.85	0.884

$\bar{x}$: Mean, SD: Standard deviation

Measurements

Bruininks Oseretsky Test Second version BOT-2, SF was developed by Bruininks and Bruininks[22] to measure the motor skills of children aged between 4.5-21. In the test, a maximum of two trials is allowed. If the child could not reach the highest score on the first try, he/she performed the second test. Only 4 sub-items of BOT-2 related to upper extremity functions were measured: fine motor skills, fine motor precision, manual dexterity, and upper limb coordination. Measured skills are fine motor control (fine motor skills and fine motor precision) and manual coordination (manual dexterity and upper limb coordination). The scoring system involves recording of a raw score in terms of units (seconds, number of errors) and then converted to a numerical score. This scale is valid and reliable for evaluate the upper extremity in children with CP.[23]

Fugl-Meyer Assessment of Motor Function (FMA): The motor functions of the shoulder, elbow, forearm, wrist, and hand are assessed on the upper extremity, while those of the hip, knee, and ankle are evaluated on the lower extremity. In our study, we used only the upper extremity motor function section of the test. In the FMA, each item is rated on a three-point sequential scale (2 points for fully performed tasks, 1 for partially performed tasks, and 0 for unperformed tasks). The maximum motor performance score for the upper extremity was 66.[24] This tool can be used for assessing upper limb motor function in CP clinical diagnosis and rehabilitation.[24]

Pediatric Functional Independence Measure (Wee-FIM) was used to assess the level of functional independence of children. This measure, containing 18 items, provides information on self-care, sphincter control, mobility, locomotion, communication, and social cognitive skills in a short time with a minimum of questions. Each domain in Wee-FIM was scored on a 7-point scale. At the end of the evaluation, the total score was calculated as 18 at the lowest and 126 at the highest.[25] This scale is valid and reliable for evaluate the functional status in Turkish children with CP.[25]

Interventions

Group 1 (traditional therapy+Playstation 2-Eye Toy Play): The VR setup consisted of the Playstation 2 game console, USB-connected Eye Toy camera, Eye Toy Play game CD, Console-Display connection cable, and LCD television. Six games (Games:Beat Freak, Kung foo, Wishi Washi, Keep Ups, Boxing Chump, Slapstream, Plate Spinner, Boogie Down, Ghost Catcher, Disco Stars, Rocket Rumble, UFO Juggler, Mirror Time) were selected from Eye Toy Play and played for 10 min to improve the upper extremity functions. To encourage the use of both upper extremities, verbal stimuli were given where necessary during the game by the physiotherapist. The physiotherapist played a passive role in giving verbal stimulus in the transition from one play to another. Games with three difficulty levels (Easy/Medium/Difficult) were played in "easy" mode. Active participation in the game was taken into account rather than the concepts of score, winning, and losing. The games were administered in addition to traditional therapy for 6 weeks, twice a week and 1 hour each time. Children in this group also received traditional therapy. Traditional therapy consisted of neurodevelopmental therapy. The treatment was planned according to the needs and development of the children in their daily living activities, by selecting the actions aimed at a specific goal within the activities the child enjoys doing. Active participation of the child in the treatment was ensured. Activities such as standing up, standing, squatting, trunk control, improving balance reactions and proprioceptive sense and weight transfer, and climbing up and down stairs were practiced with using the equipment and assistive devices (exercise balls, balance boards, soft floors, treatment cushions), which is recommended in the NGT approach.[4]

Group 2 (traditional therapy): Children in this group received only traditional therapy (NDT). The NDT was as described above.

Statistical Analysis

The data obtained from the study were analyzed using the SPSS 16 statistical package program. The mean, frequency distributions, minimum-maximum, standard deviation, and percentage values of the descriptive information were calculated. The Kolmogorov-Smirnov test was used to evaluate whether the normal distribution of initial and post-training data were appropriate. The Wilcoxon signed-rank test was used to compare the results before and after training within the groups. The Mann-Whitney U test was used to compare pre and post training values between the groups. The sample size was determined using the G-Power 3.1 program. According to the reference study results, they had a large effect size (d=1.12) from "Fugl-Meyer Test" results.[26] With 15 patients in each group, 85% power was achieved with 5% type 1 error. A p value of less than 0.05 was considered to show a statistically significant result.

Ethical Consideration

Approval for the study was granted by the Non-Interventional Clinical Research Ethics Committee of University (no: 60116787-020/5680, date: 28.01.2014). The study was approved by the Pamukkale University Medical Ethics Committee, Clinical Investigation Ethics Commission. All children and their families were verbally informed, and their signed informed consent form was obtained.

RESULTS

The study was completed with a total of 30 children with HCP (11 girls, 19 boys) aged 9.8 (SD 2.3) years. There was no statistically significant difference between the demographic data of the groups ($p>0.05$) (Table 1). When the pre-training groups were compared, there was no statistically significant difference between the parameters of upper extremity functions and functional independence ($p>0.05$, Table 2).

When the pre-training and post-training data of the groups were compared, it was found that there was a statistically significant difference in the self-care and movement subdomains (locomotion and transfers activity), communication, and total of Wee-FIM; in all parameters of Fugl-Meyer (except of upper extremity and wrist in Group 1) and in all parameters of BOT-2 SF in only Group 2 after training compared to before-training ($p<0.05$, Table 3), whereas the difference in all outcomes was not statistically significant ($p>0.05$, Table 3).

In the Group 1, it was found that the difference in hand, coordination and speed of FMA, and self-care, transfer, and locomotion of Wee-FIM in the total score was statistically significant ($p<0.05$), while the difference in all other outcomes was not statistically significant ($p>0.05$, Table 3).

When the results were compared between the groups after the training, only the FMA results in which upper extremity motor functions were assessed were found to be statistically significant in favor of the Group 1 ($p<0.05$, Table 4), with an increase in manual coordination and speed.

DISCUSSION

In a recent study, which was designed to investigate the effects of VR therapy performed through Playstation 2-Eye Toy Play on upper extremity functions and functional independence of children with HCP, the Group 1 was treated with Playstation 2-Eye Toy Play in addition to traditional therapy and the Group 2 received only traditional therapy. Because of a recent study, we found that therapies applied in both groups had a positive effect on upper limb functions and functional independence level in children with HCP. When the groups were compared, it was found that the hand functions, coordination, and speed of the training group were better than the traditional therapy group.

One of the major problems of children with CP is impaired motor function in the arm and hand. Arm

Table 2. Comparison of pre-training values of BOT 2-SF Test, Fugl-Meyer Motor Function test, Wee-FIM				
Evaluation parameters (before training)	**Traditional therapy group $\bar{x}$±SD**	**Playstation Eye-Toy 2 group $\bar{x}$±SD**	**z**	**p***
BOT2-SF fine motor control	14.20±5.03	13.93±4.28	-0.167	0.868
Manual coordination	6.00±2.17	6.06±1.66	-0.465	0.642
Fugl-Meyer upper extremity	25.06±4.31	26.06±3.39	-0.522	0.602
Wrist	5.53±2.87	5.80±2.21	-0.021	0.983
Hand	8.73±2.52	10.20±2.07	-1.466	0.143
Coordination/speed	3.26±0.70	3.80±0.77	-1.683	0.092
Total	42.60±9.19	45.86±7.22	-0.499	0.618
Wee-FIM self-care	29.93±4.36	32.13±4.89	-1.193	0.233
Sfincter control	13.86±0.51	13.86±0.51	0.000	>0.999
Transfer activity	19.06±1.33	19.53±1.92	-0.958	0.338
Locomotion	11.40±1.18	11.80±1.32	-1.045	0.296
Communication	12.26±1.43	12.86±1.35	-1.180	0.238
Cognitive skills	18.40±2.16	18.40±1.80	-0.129	0.898
Total	104.40±7.94	108.60±10.06	-1.494	0.135

*p<0.05, $\bar{x}$: Mean, SD: Standard deviation, BOT2-SF: Bruininks-Oseretsky-Short Form, FIM: Functional Independence Measure

Table 3. Comparison of pre and post-training values of BOT 2-SF Test, Fugl-Meyer Motor Function Test, Wee-FIM								
	Traditional therapy group				**Playstation Eye-Toy 2 group**			
Evaluation parameters	**$\bar{x}$±SD before training**	**$\bar{x}$±SD after training**	**z**	**p***	**$\bar{x}$±SD before training**	**$\bar{x}$±SD after training**	**z**	**p***
BOT2-SF fine motor control	14.20±5.03	15.06±3.12	-0,774	0.439	13.93±4.28	15.86±3.22	-3.415	**0.001***
Manual coordination	6.00±2.17	6.60±2.19	-1.501	0.133	6.06±1.66	8.00±2.13	-3.204	**0.001***
Fugl-Meyer upper extremity	25.06±4.31	25.66±4.25	-1.612	0.107	26.06±3.39	28.06±3	-3.426	**0.001***
Wrist	5.53±2.87	6.00±3.04	-1.890	0.059	5.80±2.21	6.46±2.44	-3.409	**0.001***
Hand	8.73±2.52	9.60±2.26	-2.804	**0.005**	10.20±2.07	11.93±1.79	-2.282	**0.022***
Coordination/speed	3.26±0.70	3.60±0.50	-2.236	**0.025**	3.80±0.77	4.13±0.74	-3.207	**0.001***
Total	42.60±9.19	44.93±9.54	-2.822	**0.005**	45.86±7.22	50.60±6.88	-3.308	**0.001***
Wee-FIM self-care	29.93±4.36	31.26±4.00	-2.300	**0.021**	32.13±4.89	34.33±4.57	-2.490	**0.013***
Sfincter control	13.86±0.51	13.86±0.51	-0.000	1.000	13.86±0.51	13.86±0.51	-0.000	>0.999
Transfer activity	19.06±1.33	19.60±1.54	-2.271	**0.023**	19.53±1.92	19.66±1.75	-1.414	0.157
Locomotion	11.40±1.18	12.00±1.00	-3.000	**0.003**	11.80±1.32	12.13±1.30	-2.271	**0.023***
Communication	12.26±1.43	12.40±1.40	-1.414	0.157	12.86±1.35	12.86±1.35	-3.089	**0.002***
Cognitive skills	18.40±2.16	18.66±1.91	-1.633	0.102	18.40±1.80	18.86±1.76	-1.890	0.059
Total	104.40±7.94	107.80±7.24	-3.436	**0.001**	108.60±10.06	111.73±9.46	-3.308	**0.001***

*Wilcoxon signed rank test, p<0.05, $\bar{x}$: Mean, SD: Standard deviation, BOT2-SF: Bruininks-Oseretsky-Short Form, FIM: Functional Independence Measure

Table 4. Comparison of post-training values of BOT 2-SF Test, Fugl-Meyer Motor Function Test, Wee-FIM				
Evaluation parameters	**Traditional therapy group x̄±SD**	**Playstation Eye-Toy 2 group x̄±SD**	**z**	**p ***
BOT2-SF fine motor control	15.06±3.12	15.86±3.22	-0.897	0.369
Manual coordination	6.60±2.19	8.00±2.13	-1.616	0.106
Fugl-Meyer upper extremity	25.66±4.25	28.06±3.12	-1.898	0.058
Wrist	6.00±3.04	6.46±2.44	-0.211	0.833
Hand	9.60±2.26	11.93±1.79	-2.991	**0.003**
Coordination/speed	3.60±0.50	4.13±0.74	-2.538	**0.011**
Total	44.93±9.54	50.60±6.88	-1.808	0.071
Wee-FIM self-care	31.26±4.00	34.33±4.57	-1.748	0.080
Sfincter control	13.86±0.51	13.86±0.51	-0.000	1.000
Transfer aktivity	19.60±1.54	19.66±1.75	-0.191	0.849
Motion activity	12.00±1.00	12.13±1.30	-0.429	0.668
Communication	12.40±1.40	12.86±1.35	-0.934	0.350
Cognitive skills	18.66±1.91	18.86±1.76	-0.391	0.696
Total	107.80±7.24	111.73±9.46	-1.620	0.105

*Mann-Whitney U test, $p<0.05$, x̄: Mean, SD: Standard deviation, BOT2-SF: Bruininks Oseretsky-Short Form, FIM: Functional Independence Measure

movements are critical in terms of capturing and grasping during daily activities. Therefore, a significant proportion of rehabilitation should maximize the upper extremity motor functions in the affected arm.[20,27] In studies, various training modalities have been used to ensure participation of the affected arm during rehabilitation.[20,28,29]

Compared with conventional therapy, the working mechanism of VR remains unclear. Recently, Levac et al.[30] has proposed 9 potential active compounds that help improve the motor skills of VR therapy from different perspectives: (1) application opportunities, recurrent task practice develops functional skills, (2) VR and movements in the real world, (3) individualization flexibility of training parameters, (4) visual and/or auditory feedback, (5) social game consensus for participation in play, (6) neuroplastic changes, (7) problem solving through different virtual contexts, and (8) motivation, since children can choose any game to play and compete with their peers, and (9) receive support from the parent or therapist using verbal encouragement and feedback. All these components are important when learning and improving motor skills from a motor learning perspective. For this reason, all of these components can be part of the basic mechanism that describes how VR works.

In a meta-analysis study that examined the effect of VR on upper extremity functioning in children with CP, it has been reported that VR is a suitable tool for improving upper extremity function in children with C; however, a stronger research design is needed for a definite recommendation. Jannink et al.[20] state that Eye Toy is a motivating educational tool for children with CP and can improve upper extremity function. In the literature, Playstation 2-Eye Toy Play has been used so far in the rehabilitation of individuals with mental and developmental disorders, stroke, and children with CP.[18,19] Additionally, it has been reported that this method is an entertaining activity that improves children's satisfaction and motivation feelings, self-esteem, and physical health in studies examining the effect of VR on the upper extremity.[19,31] All these results emphasize the importance of VR in improving upper extremity functions in children with HCP.

In the literature, BOT-2 was used to assess motor skills about VR applications for CP and it was stated that motor skills were improved in children with CP.[32] In a study conducted with Eye Toy Play at home, motor performance improved in only 1 child out of 3 children with CP.[31] Improvement in the speed and manual skill subdomains of BOT-2 has been observed in the study conducted using a different training method in the virtual environment.[33] In another study conducted with the Nintendo Wii, it was seen that motor performance improved.[31] In parallel with the literature in our study, we used a subtest of BOT-2 SF related to the upper extremity to examine the effects of Eye Toy Play on motor proficiency and save time. Additionally, we used the traditional therapy group, unlike other studies. A significant improvement in post-training BOT-2 SF for all subdomain results in the training group showed that Eye Toy Play makes a significant contribution to the improvement in motor skills related to the upper extremity. However, it is thought that this result that makes a difference between the groups may be due to the low number of training sessions with VR.

The other methods which was used in the literature other than the Fugl-Meyer test to investigate the effect of VR treatment on upper extremity function in children with hemiplegic CP and improvements were observed after treatment according to this method.[34,35] The Fugl-Meyer test is a standard clinical assessment method for evaluating upper extremity motor function in children with CP.[35] According to this test, upper extremity motor functions improve in children with CP in different training modalities.[36,37] In a study investigating the effect of VR in stroke patients, the Fugl-Meyer test was used and according to the test results, all domains of improvement were seen after training, although it differs from the age group of our study.[27] In our study, we found that all subdomain results of Fugl-Meyer in the training group improved, whereas only hand, coordination/speed, and total scores in the control group were significantly impairment compared with the pre-training. When we compared groups after training, the training group showed a significant improvement in hand functions and coordination speed parameters, indicating that Eye Toy Play performed a positive impact on hand functions and children's speed and coordination skills. In line with this result, we recommend the Eye Toy Play for these children to improve their coordination and speed with hand functions.

Winkels et al.[38] said that Wii was observed to be performed more easily in the daily activities of children with CP. There is one study in the literature on the effect of VR on functional independence. Acar et al.[19] divided the children with CP into two as combined Nintendo Wii and NDT training group and only the NDT-treated group as in our study, and improvement in self-care domain in terms of functional independence was observed in the group that received both NDT and Nintendo Wii. We can assume that a positive contribution to the functional independence level of children with HCP is achieved with Eye Toy Play because of significant improvement in many post-training subdomains. However, we think that there is no difference between the groups due to the short-term application of VR training. Additionally, the performance of children with CP in their daily activities may be related to good upper extremity functioning. We believe that the improvement in speed, coordination, and hand functions after training may help increase functional independence levels of children with HCP in the long term.

We obtained more favorable improvements with Eye Toy Play applied in addition to traditional therapy in the results of all evaluations after the training. Also, when comparing the groups, it was seen that Playstation 2-Eye Toy Play had better results in terms of hand functions and coordination-speed. Children can be more advanced in coordination/speed domains with hand functions because they feel they are in a contest for the computer game and allow for very repetitive activities. Also, according to our observations, Playstation 2-Eye Toy Play had more fun and participated more actively in the activities for children with HCP. This situation emphasizes once again the importance of the game in training with children.

Study Limitations

There were several limitations in this study. Our first limitation was that Eye Toy Play could not be performed in more sessions and at home in the training group. Also, since it was impossible to have no treatment in the control group, the treatment times of the 2 groups were not equal. The final limitation was that we did not examine the long-term effects of Playstation 2-Eye Toy Play.

CONCLUSION

As a result, VR applications administered with Eye Toy Play applied in addition to traditional training also affect traditional therapy in children with HCP, in addition to improving upper extremity functions and functional independence level and especially with hand functions and coordination and speed. There is a need for further studies conducted by examining the long-term effects of Playstation 2-Eye Toy Play with more sessions in children with HCP.

Ethics

Ethics Committee Approval: Approval for the study was granted by the Non-Interventional Clinical Research Ethics Committee of Pamukkale University (no: 60116787-020/5680, date: 28.01.2014).

Informed Consent: Informed consent was obtained from all study parents of children and assurances were given of the confidentiality of the information.

Peer-review: Externally peer-reviewed.

Authorship Contributions

Concept: B.B.Ç., Design: B.B.Ç., E.K., Data Collection or Processing: U.G., Analysis or Interpretation: B.B.Ç., S.Y.Ç., Literature Search: S.Y.Ç., Writing: B.B.Ç.

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