

The Development of Virtual Reality-based Cognitive Therapy in Children with Brain Lesions

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Objective

Existing cognitive therapy such as paper and pencil tasks and computerized cognitive training for children with brain lesions has limitation with the use of pencils, keyboards, or unrealistic scenes. The purpose of this study is to develop and apply a virtual reality (VR)-based cognitive therapy with realistic scenes, simple operations, and adequate difficulty level for children with brain lesions.

Methods

VR-based cognitive therapy was developed to enable use with simple reaching gestures to perform cognitive tasks. The hardware of VR-based cognitive therapy uses motion sensors(Kinect®) and physical user interface(PUI) to detect children behavior and provide sensory feedback based on the outcome and concentration of the training(Fig 1). The program of cognitive therapy was developed in the three categories(visualization and reasoning, attention and memory, and activity of daily life) and 13 sub-items. The level of difficulty in the program is from 1 to 5, which is divided by the changes in the number, characteristics and location of objects and time limit. To evaluate the efficacy of the therapy, 2 patients had conventional therapy using paper and pencil task(control group) and 2 patients had VR-based therapy(experimental group). The therapy consists of total 20 session, 30 minutes/session/day in both groups(Table 1). In order to compare the effects before and after therapy, motor-free visual perception test(MVPT) or developmental test of visual perception(DTVP), attention diagnostic system(ADS), pediatric volitional questionnaire(PVQ) and verbal cue frequency of the therapist were evaluated.

Result

In the control group, visual perception test score decreased after cognitive therapy, but in the experimental group, visual perception score increased. Also, in comparison with the control group, the impulsiveness in ADS and verbal cue of the therapist decreased and the participation of therapy in PVQ increased in the experimental group(Table 2).

Conclusion

VR-based cognitive therapy showed more improvement in the visual perception function and participation of the children than the conventional therapy. So, VR-based cognitive therapy will be helpful for children with brain lesion who have impaired hand function and decreased participation of therapy.

Table 1. Characteristics of patients

Group	Patients	Gender / Age	Diagnosis
Control	1	Male/11	CP
	2	Male/13	CP
Experimental	3	Male/9	CP
	4	Male/6	CP

CP, Cerebral palsy

Table 2. Comparison of visual perception assessment and degree of the participation of patients before and after therapy

Group	Patients	Treatment	Visual perception	Inattention ^{a)}	Impulsiveness ^{b)}	PVQ	Frequency of verbal cue
Control	1	Before	29*	246/132	78/100	17	70
		After	23*	327/149	76/45	29	81
	2	Before	33*	165/121	153/83	16	51
		After	22*	232/110	99/105	22	55
Experimental	3	Before	32*	294/87	39/75	38	21
		After	33*	235/128	41/42	47	12
	4	Before	33**	78/67	119/79	28	32
		After	40**	254/74	40/72	42	25

*Motor-free visual perception test(MVPT), **DTVP(Developmental test of visual perception);

^{a)}Inattention in ADS(visual/auditory), ^{b)}Impulsiveness in ADS(visual/auditory);

PVQ, pediatric volitional questionnaire



Fig 1. PUI and software image of VR-based program