Effect of home-based exercise program with augmented reality system on balance in stroke patients

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Objective
Recent advances in the augmented reality (AR) technology have significantly extended to the clinical rehabilitation in patients with stroke. The aim of this study is to investigate the effects of the home-based exercise program with the AR system to improve balance in stroke patients.

Materials and Methods
 The home-based exercise program with AR system was designed as prospective, randomized controlled study with blind observer. Subacute hemispheric stroke patients who can walk independently on the surface without severe cognitive impairment were recruited in this study. We analyzed data of total 32 stroke patients who completed functional assessment immediately after the intervention for 4 weeks. In the experimental group (n=18), we provided the home-based exercise program with the AR system (Uincare®) which was composed with the task-specific game-based system. In the control group (n=14), the written home-based exercise pogrom was provided. All participants were recommended the home-based exercise with 30 minutes a day for 4 weeks. Functional assessments with Timed Up and Go test (TUG), Tinetti Performance Oriented Mobility Assessment, and Berg Balance scale were performed before and after the intervention for 4 weeks.

Results
There was no significant difference in general and functional characteristics before the intervention (Table 1). In each group, there was a significant improvement on balance after the home-based exercise for 4 weeks (p<0.05, table 2). In addition, the change of TUG for 4 weeks was significant higher in the experimental group than the control group (p<0.05). There was no serious adverse effect in both groups.

Conclusions
This study was the first clinical trial to use the home-based exercise program with AR system in stroke patients. In addition, the results of present study revealed that a therapeutic effects of the home-based exercise program with the AR system to improve balance in stroke patients. Further study with larger number of patients will be needed to clarify the effects of the home-based exercise program with the AR system.

Table 1. Demographic and Functional Characteristics in Each Group

	Experimental group (n=18)	Control group (n=14)	P-value
Demographic characteristics			
Sex (M : F)	13 : 5	13 : 1	0.138
Age (yrs)	57.6±16.8	63.8±8.6	0.221
Height (cm)	166.2±9.7	167.9±5.2	0.543
Weight (kg)	69.5±11.6	69.1±8.4	0.911
Body mass index	25.1±2.8	24.4±2.7	0.522
Stroke type (ischemic : hemorrhage)	14 : 4	13 : 1	0.244
Affected side (right : left)	9 : 9	3 : 11	0.098
Stroke duration (months)	2.1±2.1	1.2±1.7	0.196
Functional characteristics			
K-MMSE	28.2±2.0	28.0±1.8	0.748
FAC (3 : 4 : 5)	4 : 8 : 6	3 : 4 : 7	0.586

Demographic and Functional Characteristics in Each Group

Table 2. Change of Balance and Mood after Intervention in Each Group

	T0	T1	P-value
Timed Up and Go test (s)			
Experimental group	14.0±5.8	11.6±3.6*	<0.001
Control group	11.8±2.9	11.6±3.1*	<0.001
POMA			
Experimental group	25.7±3.6	26.6±2.7*	0.023
Control group	26.8±2.2	27.4±1.6*	<0.001
Berg Balance scale			
Experimental group	51.7±5.8	53.5±3.7*	0.006
Control group	53.3±2.6	54.3±2.5*	0.002
K-GDS-SF			
Experimental group	5.1±4.2	4.6±4.8*	<0.001
Control group	5.8±4.8	4.4±3.7	0.115
EQ-5D			
Experimental group	0.8261±0.1347	0.8750±0.7333	0.359
Control group	0.8391±0.1042	0.8751±0.0770	0.093
K-FES			
Experimental group	23.9±7.9	22.3±7.7*	0.008
Control group	19.9±6.0	19.6±5.4	0.260
K-PASE			
Experimental group	84.5±54.0	105.0±68.7	0.058
Control group	105.6±76.7	123.7±73.4	0.320

POMA, Tinetti Performance Oriented Mobility Assessment; BBB, Berg Balance scale; K-GDS-SF, Korean-Geriatric Depression Scale- Short Form; K-FES, Korean Falls Efficacy Scale; K-PASE, Korean version of Physical Activity Scale for the Elderly (K-PASE)

*$p < 0.05$

Change of Balance and Mood after Intervention in Each Group