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The effect of walking rehabilitation using Healbot T on walking ability for stroke

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OBJECTIVE
There were several studies on the effect of robot therapy on improvement in functional gait in stroke patients. However, there were few studies about robot therapy using the gait training system including the concept of posture control through pelvic motion. Furthermore, there were also few studies on CIMT (Constraint-Induced Movement Therapy) in lower extremities, which was known to have therapeutic effect in the upper extremities. The aim of this study was to investigate the effects of the newly developed exoskeleton-type lower limb rehabilitation robot Healbot T–assisted gait training for patients with stroke.

METHODS
This study was a single-blinded, prospective, randomized controlled trial that compared the effects of Healbot T–assisted gait training with those of conventional physiotherapy. We enrolled 47 patients with chronic stroke and with Functional Ambulation Category scores ⩾2. The patients were randomly assigned to one of four treatment groups: 30minutes of training with Gait Rehabilitation without Healbot T (Control Group), Healbot T Gait Rehabilitation (Pelvic off Group), Healbot T Gait Rehabilitation with pelvic control (Pelvic on Group), Healbot T Gait Rehabilitation with Constraint Induced Movement Therapy (CIMT Group). All received treatment 10 times for four weeks. The outcomes were assessed using the Functional Ambulation Classification (FAC), 10 Meter Walking (10MW) Test, Timed Up and Go (TUG) Test, Berg Balance Study (BBS), Motricity Index (MI)-Lower.

RESULTS
A total of 4 patients were lost to follow-up, leaving a cohort of 43 for the final analyses. No significant differences of demographics and clinical characteristics were seen between groups, with the exception of baseline MI-Lower (Table 1). We mesured the difference of clinical variables before and after four weeks of rehabilitation for each groups. After treatment, pelvic on and CIMT groups showed significant improvements of BBS score (Table 2). We also measured the differences in the score between control and robot groups (including pelvic off, pelvic on, CIMT group). In BBS score, the robot group showed greater

improvement than the control group (3.1 ± 2.3 and 1.1 ± 2.0, respectively; P=0.02). And MI-Lower of the affected limb improved more in the robot group than the control group (6.6 ± 5.1 and 2.3 ± 4.3, respectively; P=0.02) (Table 3).

CONCLUSION
Our results suggest that balance and voluntary strength of chronic stroke patients might be improved with Healbot T-assisted gait training than conventional physiotherapy alone. Furthermore, the posture control through pelvic motion of the Healbot T might be more helpful in improving the balance.

Table 1. Demographics and baseline clinical characteristics by groups

	Control Group (n=10)	Pelvic off Group (n=10)	Pelvic on Group (n=12)	CIMT Group (n=11)	*p-value*
Age	66.4±7.2	62.5±5.9	64.6±8.1	63.8±6.1	*0.69*
Gender (n)					*0.05*
Female	4	5	1	7	
Male	6	5	11	4	
Height (cm)	161.9±10.6	161.0±8.4	165.7±6.8	158.0±7.0	*0.33*
Weight (kg)	64.5±14.0	68.0±11.6	68.2±8.1	64.8±8.8	*0.86*
Time post-stroke (months)	13.5±5.5	17.2±11.3	14.2±8.1	14.0±4.8	*0.95*
[a]**FAC**	4.9±0.7	4.5±0.7	4.6±1.2	4.0±0.6	*0.12*
[a]**10MW (m/s)**	0.6±0.2	0.7±0.2	0.7±0.3	0.6±0.2	*0.98*
[a]**TUG**	18.4±5.3	18.2±6.0	18.5±7.1	21.3±9.4	*0.87*
[a]**BBS**	48.0±2.4	47.8±4.5	47.3±4.4	43.8±4.2	*0.09*
[a]**MI-Lower**	62.1±7.1	58.8±7.4	62.3±7.7	53.3±4.7	***0.01***

The data are presented as mean ± standard deviation or numbers (%)
Abbreviations : FAC, Functional ambulatory category; 10MW, 10m walk test; TUG, Time up and go;
BBS, Berg balance scale; MI, motricity
p< .05 was considered to be statistically significant. p-value was comparison of groups
[a]Baseline data of FAC, 10MW, TUG, BBS, MI-Lower

Table 2. Difference after treatment according to four groups

	Control Group (n=10)	Pelvic off Group (n=10)	Pelvic on Group (n=12)	CIMT Group (n=11)	p-value
ΔFAC	0.1±0.3	0.2±0.4	0.3±0.5	0.2±0.4	0.89
Δ10MW (m/s)	0.1±0.1	0.1±0.1	0.1±0.1	0.0±0.1	0.03*
ΔTUG	-0.9±2.1	-2.8±3.4	-4.8±5.8	-1.3±1.2	0.12
ΔBBS	1.1±2.0	2.2±2.1	3.9±2.2	2.9±2.4	0.04*
ΔMI-Lower	2.3±4.3	8.2±6.7	5.8±5.3	5.9±3.0	0.07

The data are presented as mean ± standard deviation or numbers (%)

Abbreviations : FAC, Functional ambulatory category; 10MW, 10m walk test; TUG, Time up and go;

BBS, Berg balance scale; MI, motricity

p< .05 was considered to be statistically significant. p-value was comparison of groups

Table 3. Difference after treatment between control and robot groups

	Control Group (n=10)	[a]Robot Group (n=33) (including Pelvic off (n=10), Pelvic on (n=12), CIMT (n=11))	p-value
ΔFAC	0.1±0.3	0.2±0.4	0.51
Δ10MW (m/s)	0.1±0.1	0.1±0.1	0.23
ΔTUG	-0.9±2.1	-3.0±4.2	0.07
ΔBBS	1.1±2.0	3.1±2.3	0.02*
ΔMI-Lower	2.3±4.3	6.6±5.1	0.02*

The data are presented as mean ± standard deviation or numbers (%)

Abbreviations : FAC, Functional ambulatory category; 10MW, 10m walk test; TUG, Time up and go;

BBS, Berg balance scale; MI, motricity

p< .05 was considered to be statistically significant. p-value was comparison of control and robot groups.

[a]The robot groups include pelvic off, pelvic on, and CIMT groups.