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The Effects of Training with a Rehabilitation Device(Rebless Planar®) on Upper Limb Function in Chronic Stroke Patients

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Introduction

❖ Upper limb dysfunction is one of the most common complications of stroke and is closely related to activities of daily living.

❖ Rebless Planar® is a medical robot for rehabilitation that is designed to assist upper limb training, especially shoulder and elbow.

❖ We aimed to study the effects of training with Rebless Planar® on upper limb function in chronic stroke patients.

Methods

❖ This study is a single-center, parallel-group, randomized controlled trial.

❖ **Inclusion criteria**
- Age > 19 years
- Hemiparetic stroke patients
- Modified Ashworth scale < 3 in elbow, wrist, finger joint

❖ **Rebless Planar® group (10 patients, 10 sessions)**
- Calibration and setting (2 min.)
- Orientation (1 min.)
- Point-to-point reaching exercise (8 min.)
- Resting (1.5 min.)
- Maze game (8 min.)

Figure 1. Rebless Planar®

❖ Control group (10 patients, 10 sessions)
- Patients were treated by conventional rehabilitation program using MOTOmed®, 30 minutes per session.

❖ **Outcome measures**
- Fugl-Meyer assessment of the upper extremity(FMA-UE)
- Modified Barthel index(MBI)
- Modified Ashworth scale(MAS) and range of motion(ROM) of elbow and wrist joint
- Motricity index of the upper extremity(MI_upper)
- Duration and straightness measured by Rebless Planar®

Results

Table 1. Baseline Characteristics

Characteristics	Rebless planar® (N=10)	Control (N=10)	P-value
Age (years)	69.50 ± 8.00	62.80 ± 6.44	0.054
Gender (n (%))			1.000
Male	7 (70.00)	6 (60.00)	
Female	3 (30.00)	4 (40.00)	
Height (cm)	163.60 ± 8.06	166.00 ± 7.59	0.502
Weight (kg)	62.40 ± 10.92	64.30 ± 10.53	0.697
BMI (kg/m²)	22.90 ± 3.14	23.60 ± 4.40	0.970
Stroke Etiology (n (%))			0.650
Infarction	7 (70.00)	5 (50.00)	
Hemorrhage	3 (30.00)	5 (50.00)	
Affected side (n (%))			0.370
Left	3 (30.00)	6 (60.00)	
Right	7 (70.00)	4 (40.00)	
Time after onset (months)	90.90 ± 31.10	84.80 ± 26.91	0.645

Values are presented as mean±SD.

Table 2-1. Outcome measures – Fugl-Meyer assessment of the upper extremity, modified Barthel index

	Rebless planar® (N=10)	Control (N=10)	P-value
[FMA-UE]			
Baseline	38.30 ± 7.39	35.30 ± 18.92	
Follow-up	43.50 ± 7.50	36.90 ± 19.16	
Change from baseline	5.20 ± 2.04	1.60 ± 2.99	0.010*
P-value	0.002*	0.125	
[MBI]			
Baseline	81.10 ± 9.10	91.50 ± 4.43	
Follow-up	83.70 ± 7.69	91.80 ± 3.99	
Change from baseline	2.60 ± 2.80	0.30 ± 0.67	0.016*
P-value	0.016*	0.500	

Values are shown as mean±SD. *p < 0.05. FMA-UE, Fugl-Meyer assessment of the upper extremity, MBI, modified Barthel index. For the stastical analysis, Wilcoxon's signed rank test and Wilcoxon's rank sum test were performed.

Table 2-2. Outcome measures – Range of motion

	Rebless planar® (N=10)	Control (N=10)	P-value
Elbow flexion			
Baseline	131.00 ± 13.29	122.00 ± 14.38	
Follow-up	136.50 ± 8.83	125.00 ± 12.91	
Change from Baseline	5.50 ± 7.25	3.00 ± 5.87	0.408
P-value	0.040*	0.141	
Elbow extension			
Baseline	-3.50 ± 9.44	-10.00 ± 13.12	
Follow-up	-4.00 ± 9.37	-8.00 ± 12.06	
Change from baseline	-0.50 ± 1.58	2.00 ± 4.83	0.196
P-value	1.000	0.375	
Wrist flexion			
Baseline	54.50 ± 15.17	63.00 ± 10.33	
Follow-up	62.00 ± 12.29	61.50 ± 8.83	
Change from baseline	7.50 ± 9.50	-1.50 ± 5.30	0.018*
P-value	0.034*	0.394	
Wrist extension			
Baseline	46.50 ± 23.69	54.00 ± 15.06	
Follow-up	51.00 ± 19.83	58.50 ± 11.56	
Change from baseline	4.50 ± 13.01	4.50 ± 9.26	1.000
P-value	0.302	0.159	

Values are shown as mean±SD. *p < 0.05. For the stastical analysis, Wilcoxon's signed rank test and Wilcoxon's rank sum test were performed.

Table 2-3. Outcome measures – Modified Ashworth scale, motricity index of the upper extremity

	Rebless planar® (N=10)	Control (N=10)	P-value
[MAS – Elbow flexor]			
Baseline	1.00 ± 0.78	0.95 ± 1.12	
Follow-up	0.65 ± 0.75	0.85 ± 1.16	
Change from baseline	-0.35 ± 0.53	-0.10 ± 0.39	0.248
P-value	0.125	0.750	
[MAS – Elbow extensor]			
Baseline	0.15 ± 0.47	0.50 ± 0.82	
Follow-up	0.25 ± 0.54	0.55 ± 0.72	
Change from baseline	0.10 ± 0.32	0.05 ± 0.37	0.626
P-value	1.000	1.000	
[MAS – Wrist flexor]			
Baseline	0.55 ± 0.72	0.75 ± 0.98	
Follow-up	0.40 ± 0.66	0.60 ± 0.97	
Change from baseline	-0.15 ± 0.34	-0.15 ± 0.34	1.000
P-value	0.500	0.500	
[MAS – Wrist Extensor]			
Baseline	0.20 ± 0.42	0.20 ± 0.42	
Follow-up	0.20 ± 0.42	0.20 ± 0.42	
Change from Baseline	0.00 ± 0.47	0.00 ± 0.00	1.000
P-value	1.000	-	
[MI_upper]			
Baseline	73.00 ± 5.10	62.50 ± 22.08	
Follow-up	74.80 ± 2.53	63.00 ± 21.15	
Change from baseline	1.80 ± 4.05	0.50 ± 1.58	0.504
P-value	0.500	1.000	

Values are shown as mean±SD. MAS, modified Ashworth scale, MI_upper, motricity index of the upper extremity.

Table 3. Difference of duration and straightness measured by Rebless Planar®

	Rebless planar® (N=10)	Control (N=10)	P-value
Duration (Last – first)			
Least square means	-0.389	-0.024	
Standard error	0.116	0.116	
95% confidence interval	-0.622 -0.157	-0.257 0.209	0.030*
P-value	0.001*	0.837	
Straightness (Last – first)			
Least square means	-0.080	0.008	
Standard error	0.040	0.040	
95% confidence interval	-0.161 0.000	-0.073 0.089	0.116
P-value	0.051	0.841	

For the stastical analysis, least squares regression method was performed.

Conclusion

❖ Rebless Planar® can help chronic hemiparetic stroke patients in improving the function of upper extremity and activities of daily living.

❖ Additional study in larger group size or population with earlier onset may be helpful to identify further efficacy and effectiveness of the rehabilitation device.