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Clinical Efficacy of Robot-Assisted Upper Extremity Rehabilitation in Stroke Patients: A Case Series

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Introduction

- Upper extremity movement disorder: typical sequela of stroke
  - ✓ Intensive training and repetitive practice of functional tasks : effective role in **neuroplasticity**
- **Robot-assisted upper extremity rehabilitation**
  - ✓ Effective method to increase neuroplasticity along with constraint-induced movement therapy
  - ✓ Treatment using serious games: more effective than conventional rehabilitation treatment
  - ✓ Camillo® (Man&Tel Co. Ltd): **End-effector type robot** for upper extremity training (1) serious game contents, (2) multiple positioning (horizontal, vertical, and inclined planes)

Methods

- **Six** patients with stroke (hemiplegia), mean age 76.5 years
- **Intervention**: robot-assisted upper extremity training for 20min/day, 5 days/week, for 3 weeks
- Outcome measures were evaluated at admission (**E1**) and discharge (**E2**)
- **Primary outcome**: Fugh-Meyer Assessment (FMA) and Modified Barthel Index (MBI)
- **Secondary outcome**: upper extremity motor score (UEMS), hand grip strength, Box and Block Test (BBT), 9-Hole Peg Board Test (PBT), and Mini-Mental State Examination (MMSE)

Results

- Type of stroke: **4** ischemic stroke, **2** hemorrhagic stroke
- Side of weakness: **5** left hemiplegia, **1** right hemiplegia

Table 1. Demographic data of the participants.

Participant No.	Age (yr)	Sex	Type of stroke	Lesion of stroke	Side of weakness
1	92	M	**Hemorrhagic**	**Lt thalamus**	**Rt**
2	78	F	**Ischemic**	**Rt MCA territory**	**Lt**
3	45	F	**Ischemic**	**Rt Pons**	**Lt**
4	85	F	**Hemorrhagic**	**Rt BG**	**Lt**
5	76	M	**Ischemic**	**Rt ICA territory**	**Lt**
6	83	F	**Ischemic**	**Rt MCA territory**	**Lt**

M: male, F: female, Rt: right, Lt: left
MCA: middle cerebral artery, ICA: internal carotid artery, BG: basal ganglia

- **Primary outcome**
  - ✓ All patients showed improved FMA. Except for patient No. 3.
  - ✓ MBI showed improvement after intervention.
- **Secondary outcome**
  - ✓ MMT improved with increased proximal muscle strength except for patients 2. Grip strength test showed improvement in patient No. 1, 3, 5 and 6.
  - ✓ BBT showed improvement in patient No. 1, 2, 5, and 6. Patients No. 2, 3, and 4 could still not perform 9-hole PBT in post-evaluation.
  - ✓ MMSE scores improved in all patients after intervention.

Table 2. Comparison of changes in outcome measures.

Participant	No.1		No.2		No.3	
	E1	E2	E1	E2	E1	E2
FMA-UE	36	42	13	25	8	37
K-MBI	26	44	29	36	23	23
UEMS	14	16	12	12	6	9
Grip strength	2.4	4	0	0	0	1.1
BBT	4	16	0	0	0	2
9-hole PBT	Not testable	156	Not testable	Not testable	Not testable	Not testable
MMSE	19	25	16	18	26	30

Participant	No.4		No.5		No.6	
	E1	E2	E1	E2	E1	E2
FMA-UE	4	35	35	48	28	66
K-MBI	13	56	63	78	52	66
UEMS	6	10	12	16	16	18
Grip strength	0	0	1.6	3.4	0	4.9
BBT	0	0	2	13	0	6
9-hole PBT	Not testable	Not testable	Not testable	210	Not testable	300
MMSE	16	18	20	22	18	27

E1: pre-evaluation, E2: post-evaluation
FMA-UE: Fugl-Meyer motor function assessment for upper extremity, MBI: Korea modified Barthel index, UEMS: upper extremity motor score, BBT: box and block test, PBT: peg board test, MMSE: mini mental state examination

Conclusion

- The results that the primary parameters, FMA and MBI, have improved in most patients indicated that robot therapy could help improve the upper extremity function in stroke patients.
- However, treatment efficacy was low in patients with high severity and low initial evaluation scores.
- Since the area of the therapeutic effect was a relatively proximal upper limb, parameters requiring an increase in distal muscle strength were not significantly improved.
- To verify the efficacy, a follow-up study will be conducted, including control groups with conventional treatment.