

Pilot Trial of a Robot-Assisted Upper Limb Therapy System

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OBJECTIVE:

To assess patient efficacy, and guide practical use of a new robot-assisted therapy platform for stroke patients.

DESIGN:

Pilot study, patients as own control.

SETTING:

Outpatient therapy program in a MossRehab.

PARTICIPANTS:

10 individuals with hemiparesis due to a stroke (mean age = 61.2 months \pm 13.28; mean stroke onset = 41.1 months \pm 38.7 months). All patients were treated in the outpatient setting, and 9 of the 10 were participants in an outpatient maintenance program. Subjects were included based on their ability to tolerate the treatment and attend to the software interface as determined by the treating therapist.

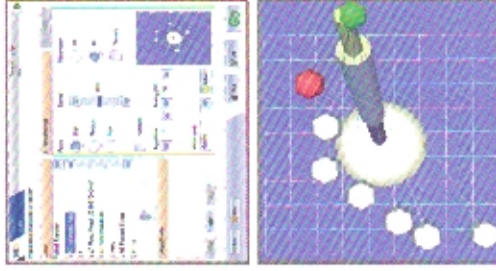
INTERVENTIONS:

Patients participated in 2 to 3 one hour sessions per week, for a maximum of six weeks, consisting of progressively engaging patients in repetitions of functionally oriented arm movements with robot assistance using the Reo™ Pro therapy platform. The Reo Pro facilitates training programs that progressively engage patient arm movements through patterns of increasing complexity, and mode of interaction. Therapy modes include Guided, Initiated, Step-Initiated, Follow Assist and Free. The entire treatment was supervised by the treating therapist. All of the Reo Pro training modes were available to the therapists. The decision to progress to the next mode was made at the discretion of the therapist based on their observations of the subjects performance.

MAIN OUTCOME MEASURES:

Clinical scales administered at baseline and discharge included: Arm portion of the upper extremity motor section of the Fugl-Meyer, Timed Up-and-Go, and data logged on the Reo Pro.

Fig. 1: Typical exercise patterns and user screen



RESULTS:

Patients received between 7 and 14 sessions of treatment, and performed between 3,380 and 11,110 functional arm movements during the course of treatment. Average session time was 50 minutes. Fugl-Meyer scores increased between 1 and 12 points, a difference which was statistically significant on average ($t = -4.386, p = 0.002$). The improvement in the Timed Up-and-Go test ranged between 1.1 and -12 seconds and was also statistically significant on average ($t = 2.97, p = 0.016$).

Overall trends as observed by the treating therapists demonstrated a reduction in perceived exertion, reduction in shoulder pain, and reduction in Ashworth score. No adverse effects were reported.

CONCLUSIONS:

- The Reo Therapy treatment was provided during the study with no identified side effects.
- Although the study subjects were all in the chronic stage of their stroke recovery, Reo Pro system was able to accommodate a wide range of patients and their correspondingly disparate physical capabilities.
- The therapists who participated in this study felt that the system was easy to use and that it is a viable therapy for their patients.
- The improvement in Fugl-Meyer scores for some patients was relatively dramatic given the chronic status of the stroke.
- Since we did not control the intensity or pattern of the treatment, it is difficult to make any assumptions about specific expected responses to the treatment for a particular patient. However, future work should address this issue.
- All ten subjects demonstrated improvement in their Fugl-Meyer score, with an increase in FM score of between 1 and 12 points.
- Average Timed Up-and-Go measures improved for 9 of the 10 patients indicating that improvement in arm function can lead to improvement in walking ability. This area merits more detailed exploration in future research.
- Future work will examine the characteristics of the patients and the content of the therapy program to understand better the relationship between the treatment and the patient outcomes.

Table 1: Subject information and scores

Subject	Age (months)	IE Fugl-Meyer			Time Up-and-Go		
		Baseline	End	Change	Baseline	End	Change
1	43	31	36	5	37	37	0
2	60	22	14	-8	21	17	-4
3	36	4	24	20	23	22	-1
4	75	2	17	15	17	17	0
5	63	44	47	3	33	32	-1
6	31	2	30	28	11	10	-1
7	74	30	45	15	37	35	-2
8	52	2	16	14	7	10	3
9	61	21	27	6	23	20	-3
10	51	50	49	-1	16	10	-6

Table 2: Statistical results of Fugl-Meyer and Timed Up-and-Go Tests

Test	Mean at Baseline	Mean at Exit	Mean difference pre-post	Significance P =
Fugl-Meyer	27.4	33.1	5.7	0.002 s.g.
Timed Up-and-Go	20.05	15.9	-4.1	0.016 s.g.

Fig. 2: Reo Pro Platform

