

Quadriceps stimulation and modified AFO in patients with hemiplegia

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Introduction

Patients with hemiplegia require a considerable amount of time with physical therapists for rehabilitation. Clinical researches demonstrated that the application of electrical stimulation via surface electrodes could increase muscle strength [1, 2]. Integration of conventional physical therapy treatment with electrical stimulation and using modified ankle foot orthosis, which were produced in the study, might improve the efficiency of rehabilitation treatment and reduce the time spent with patients.

Objectives

To compare the results of conventional physical therapy treatment with the integrated approaches using electrical stimulation and modified ankle foot orthosis (Figure 1) on the recovery of functional movements of the lower limbs in patients with hemiplegia.

Methods

Twenty-eight patients were included in the study. They were randomized to control (n = 13) and experimental groups (n = 15). The experimental group received electrical stimulation on quadriceps muscles for 20 minutes, five days per week. Time up and go for 3 meters, manual muscle testing of quadriceps and tibialis anterior (measured in sitting positions), maximal percentage of body weight on the affected leg in standing position and muscle tone were measured pre- and post-intervention. Independent samples t-test was used to test the measured parameters between groups and paired t-test was used to test between each parameter pre- and post- intervention within each group. The statistical tests were determined using SPSS version 10.0 for Windows.



Figure 1 A modified AFO used in the study

Results

There were no statistical differences in age, body weight, height, duration post-onset and other parameters (Table1). The treatment sessions in the control group were similar to the experimental group (10.6 ± 7.6 and 10.9 ± 6.7 , respectively). After the completion of the treatment, patients in the experimental and the control groups demonstrated a similar improvement in time up and go for 3 meters, tibialis anterior strength, percent

body weight on the affected leg and spasticity of lower extremity (Table 2). However, the quadriceps strength in the seated posture was significantly higher in the control group than the in the experimental group (3.3 ± 1.3 vs. 2.4 ± 0.8 , respectively; $p = 0.034$). In addition, comparison of parameters prior to and after the treatment program within each group found a significant improvement in time up and go for 3 meters, quadriceps strength and percent of body weight on the affected leg (Table 3). However, in contrast to the control group, the strength of tibialis anterior did not change in the experimental group after the intervention. The spasticity did not alter when compared between pre and post- intervention in both groups.

Table 1 Mean and SD of patients' characteristics pre-intervention

Patients' characteristics	Experiment n = 15	Control n = 13	p*
Age (years)	63.60 ± 7.96	65.85 ± 9.44	0.501
Gender (Male/Female/)	8 / 7	5 / 8	-
Side of hemiplegia (Left / Right)	8 / 7	8 / 5	-
Body weight (kg)	49.47 ± 8.99	54.43 ± 15.20	0.296
Height (cm)	155.7 ± 6.71	155.23 ± 7.71	0.865
Duration post-onset (days)	13.00 ± 12.87	6.15 ± 2.85	0.072
Number of treatment (times)	10.93 ± 6.76	10.61 ± 7.57	0.907
Quadriceps strength	1.43 ± 1.08	2.31 ± 1.23	0.056
Tibialis anterior strength	0.77 ± 1.37	1.38 ± 1.37	0.246
Max wt bearing on the affected leg (% of body wt)	30.82 ± 21.76	43.20 ± 22.57	0.152
Asworth scale	0.6 ± 0.91	0.15 ± 0.38	0.112
Time up and go 3 meters (seconds)	19.55 ± 5.07 (n = 2)	16.71 ± 8.03 (n = 3)	-

*Independent samples t-test

Table 2 Mean and SD of the measured parameters post-intervention

Measured parameters	Experiment n = 15	Control n = 13	p*
Quadriceps strength	2.43 ± 0.78	3.31 ± 1.27	0.034*
Tibialis anterior strength	1.20 ± 1.57	2.31 ± 1.81	0.094
Max wt bearing on the affected leg (% of body wt)	57.33 ± 16.47	59.09 ± 25.75	0.828
Asworth scale	0.50 ± 0.76	0.38 ± 0.51	0.649
Time up and go 3 meters (seconds)	18.29 ± 8.05 (n = 11)	18.29 ± 8.08 (n = 12)	0.988

*Independent samples t-test

Table 3 Mean and SD of measured parameters pre- and post- intervention within each group

Group	Parameters	Pre	Post	p *
Control	Quadriceps strength	2.31 ± 1.23	3.31 ± 1.27	0.001*
	Tibialis anterior strength	1.38 ± 1.37	2.31 ± 1.37	0.001*
	Max wt bearing on the affected leg (% of body wt)	43.21 ± 22.57	59.09 ± 25.75	0.004*
	Asworth scale	0.15 ± 0.38	0.38 ± 0.51	0.190
Experiment	Quadriceps strength	1.43 ± 1.08	2.43 ± 0.78	0.000*
	Tibialis anterior strength	0.77 ± 1.37	1.20 ± 1.57	0.060
	Max wt bearing on the affected leg (% of body wt)	30.82 ± 21.76	57.33 ± 16.47	0.000*
	Asworth scale	0.64 ± 0.93	0.50 ± 0.76	0.547

* Paired Samples t-test

Conclusion

Quadriceps stimulation and modified ankle foot orthosis were used in addition to the conventional physical therapy treatment. Recovery of functional movement of the lower extremity in patients with hemiplegia showed non-significant differences in ambulation, muscles strength and maximal percentage of body weight on the affected leg when compared between conventional physical therapy and the integrated approaches. The non-significant results might be due to the higher initial quadriceps strength in the control than the experimental groups. Another reason might be the intervention period of electrical stimulation, which might be not sufficient to increase the strength of quadricep muscles. Furthermore using the modified ankle foot orthosis might decrease the patient's chance of moving their ankle joints. This might cause the non-significant results of the tibialis anterior strength in the experimental group after the intervention.

References

- [1] Price, C.I.M. and A.D. Pandyan, *Electrical stimulation for preventing and treating post-stroke shoulder pain: a systematic Cochrane review*. Clin Rehabil, 2001. **15**: p. 5-19.
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