



Original Article

The effects of task-oriented training on hand dexterity and strength in children with spastic hemiplegic cerebral palsy: a preliminary study

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Abstract. [Purpose] The purpose of this study was to investigate the effects of task-oriented training (TOT) on hand dexterity and strength in children with spastic hemiplegic cerebral palsy. [Subjects and Methods] Twelve children with spastic hemiplegic cerebral palsy were randomly assigned to either the TOT group (n=6) or the control group (n=6). In both groups, conventional occupational therapy was performed 40-min/day, 2 times a week, for 4 weeks. In the TOT group, TOT was additionally performed for 20 min, and the control group received usual care. The box and block test (BBT) was performed to assess hand dexterity. Hand strength was also assessed using hand dynamometer. [Results] After intervention, the TOT group showed a significant improvement of hand dexterity. In the control group, BBT and grip strength were not significantly improved after intervention. [Conclusion] In clinical settings, we suggest that TOT may be used as an intervention to improve hand dexterity in children with spastic hemiplegic cerebral palsy.

Key words: Cerebral palsy, Task oriented training, Hand dexterity

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INTRODUCTION

Cerebral palsy (CP) is a non-progressive disorder by pre-birth, at birth, post-birth or brain injury of early infancy. CP children often experience delayed development and body movement, as well as a limitation of activity of daily living¹⁾. A previous study has reported that a spastic type accounts for 36% of all CPs²⁾. Children with hemiplegic CP suffer from spasticity, sensory deficit, and muscle weakness, affecting functions of the upper limb more than that of the lower limb³⁾.

Decreased upper limb function in children with spastic hemiplegic CP reduces the efficiency of manipulative function³⁾. Children with spastic hemiplegic CP experience problems of motor control, with inefficient movement patterns. Thus, they have a mass movement pattern and difficulty performing specific tasks¹⁻³⁾. In addition, children with spastic hemiplegic CP are limited with activities of daily living, such as dressing, feeding, and function mobility, due to problems of the upper limb and hand function⁴⁾.

Previous studies have demonstrated the effects of various interventions, such as constraint-induced movement therapy,

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Table 1. General characteristics

	TOT group (n=6)	Control group (n=6)
Age (months)	58.1 ± 7.7	57.3 ± 3.4
Gender (male/female)	4/2	2/4
GMFCS (level 1 / level 2)	3/3	4/2
Hemi side (left / right)	4/2	3/3

Values are expressed as mean ± SD.

GMFCS: Gross Motor Function Classification System

Table 2. Comparison of results between the two groups

	TOT group (n=6)		Control group (n=6)	
	Pre	Post	Pre	Post
BBT (score)	11.17 ± 6.43	13.33 ± 6.74*	11.33 ± 5.92	12.17 ± 4.45
Grip strength (kg)	2.25 ± 1.84	2.63 ± 2.51	1.92 ± 1.63	2.08 ± 1.49

Values are expressed as mean ± SD. BBT: box and block test

*p<0.05, significant difference within group

neurodevelopmental treatment, and sensory-integration, which have been suggested to improve functions of the upper limb and hand in children with CP⁵⁻⁷). Of these interventions, task-oriented training (TOT) has been the treatment approach to improve functional movement⁸⁻¹⁰).

Several studies have reported the effects of TOT on gait function in stroke patients⁸) as well as mobility in children with CP⁹). Higgins et al. has also reported that TOT significantly increases upper limb function in stroke patients¹⁰). However, a few studies have reported the effects of TOT on upper limb function in children with spastic hemiplegic CP. Therefore, this study investigated the effects of TOT on hand dexterity and strength in children with spastic hemiplegic cerebral palsy.

SUBJECTS AND METHODS

Twelve children with spastic hemiplegic CP, who were admitted to a community welfare located in Seoul, participated in this study. The inclusion criteria were as follows: 1) Diagnosis of CP (hemiplegic type), 2) age 5–13 years, 3) levels 1 and 2 on the gross motor function classification system, and 4) no history of epilepsy. The exclusion criteria were as follows: 1) Botulinum toxin A treatment for the upper limb in the previous 6 months and 2) excessive spasticity in the upper limb. Parents of the children who participated in this study were well informed about the content of the experiment and the procedure. This study was approved by the Gachon University Institutional Review Board (1044396-201604-HR-033-01).

Twelve children with CP were randomly assigned to either the TOT groups or the control group. Both groups received the same conventional occupational therapy 40 minutes a day, 2 times a week for four weeks. The TOT group additionally received TOT for 20 min, while the control group received the usual care.

In the TOT group, tasks focused on improving the upper limb function. The TOT group repeated reaching, ring activity, and stacking cup to catch the target using a paretic hand. For example, the participant stretched the arms to reach for the target point, the paretic hand to the ring activity, the paretic hand to the side, and the paretic hand to the side of body. The therapist gave feedback so that the children could train with their own volition.

Box-and-Block Test (BBT) was used to assess hand dexterity. The BBT score is a number of blocks (1 inch) moved from one box to the other box for 1 min. This test reported high inter-rater reliability ($r=0.94-0.98$) and intra-rater reliability ($r=0.99-1.00$)¹¹). Grip strength was evaluated with a Jamar dynamometer (Therapeutic Equipment Corporation, USA), in accordance with the standard procedure¹²). The score of grip strength was determined as the average of 3 trials.

The collected data were analyzed using SPSS 22. All values were expressed as the mean ± standard deviation (SD). Shapiro-Wilk test for normality of the data was used. General characteristics of children between groups were analyzed using Mann-Whitney U Test and χ^2 test. Wilcoxon signed rank test was used to compare before and after for each group. The Mann-Whitney U test was performed to compare the difference of hand dexterity and strength between the two groups. The significance level was set to 0.05.

RESULTS

A total of 12 patients completed the study. There were no significant differences between the TOT group and the control group regarding the general characteristics of children with spastic hemiplegic CP (Table 1).

For hand dexterity, as shown in Table 2, there were no significant differences of BBT between the two groups. However, in the TOT group, there was a significant improvement in hand dexterity post intervention ($p < 0.05$). There were no significant differences regarding BBT in the control group (Table 2).

Moreover, there was no improvement in grip strength in either group. After the intervention, there was no significant difference between the two groups (Table 2).

DISCUSSION

This study examined the effects of TOT on hand dexterity and strength in children with spastic hemiplegic CP. TOT significantly increased hand dexterity, but did not improve grip strength; conversely, there was no significant improvement in hand dexterity and strength after intervention in the control group. There was no significant difference between the two groups. In conclusion, we recommend that TOT be used as an intervention method to improve hand dexterity in children with spastic hemiplegic CP.

The results of this study confirmed the effect of combined TOT with conventional occupational therapy. The control group received conventional occupational therapy only. In the control group, the BBT increased from 11.33 to 12.17 after intervention, while grip strength improved from 1.92 to 2.08; but this showed no statistical significance. In the TOT group, there was no significant improvement in grip strength, going from 2.25 to 2.63 after intervention; however, in this group there was a significant improvement in BBT, going from 11.17 to 13.33 post-intervention. This result supports the notion that an increase in the intervention dosage may result in a greater improvement¹³.

Lang et al. has reported that the clinical intervention dosage is insufficient for significant brain neuroplasticity and functional recovery in stroke patients¹³. In particular, children do not receive adequate rehabilitative intervention in South Korea, due to the burden of treatment costs and clinical setting problems¹⁴. This study demonstrated that TOT with conventional rehabilitation significantly improves hand dexterity. Therefore, TOT should be provided in the rehabilitation of children with spastic hemiplegic CP.

Despite positive results for the effect of combined TOT with conventional occupational therapy, the present study has some limitations. First, the sample size was small. Additionally, this study did not confirm the long-term sustained effects after the intervention. Further studies are needed to supplement the findings of this study accounting for these limitations.

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