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Effect of Baltimore Therapeutic Equipment on Hand Motor Function and Activities of Daily Living in Children Aged 8–12 Years with Spastic Diplegic Cerebral Palsy: A Controlled Pre–Post Study

Bijayalaxmi Sahoo[1], Jeetendra Mohapatra[2], Damayanti Sethy[3]

[1]Department of Occupational Therapy, National Institute for Locomotor Disabilities (Divyangjan), Kolkata, India (study affiliation)\n
[2,3]Department of Occupational Therapy, National Institute for Locomotor Disabilities (Divyangjan), Kolkata, India (study affiliation)

ABSTRACT

Background: Children with spastic diplegic cerebral palsy may experience upper-limb motor limitations that affect hand use and everyday self-care. Task-oriented rehabilitation equipment may provide structured practice of grip, pinch, wrist movement and upper-limb activity.

Objective: To examine the effect of Baltimore Therapeutic Equipment (BTE) Primus RS training combined with conventional occupational therapy on hand motor function and functional independence in children aged 8–12 years with spastic diplegic cerebral palsy.

Methods: Thirty children were included and allocated to two groups of 15. The experimental group received 20 minutes of BTE training using attachments 151, 162, 303, 601 and 701, plus 20 minutes of conventional occupational therapy. The comparison group received 40 minutes of conventional occupational therapy. Sessions were delivered three times weekly for six weeks. Outcomes were assessed before and after intervention using the Wee Functional Independence Measure (WeeFIM) and Jebsen–Taylor Hand Function Test (JTHFT). Within-group analyses used the Wilcoxon signed-rank test and between-group analyses used the Mann–Whitney U test; $p<0.05$ was considered statistically significant.

Results: In the experimental group, mean WeeFIM increased from 80.13 (SD 15.142) to 102.00 (SD 17.034; p=0.001). In the comparison group, mean WeeFIM increased from 78.60 (SD 16.383) to 80.47 (SD 16.522; p=0.009 as reported in the dissertation). Mean JTHFT time decreased from 29.00 (SD 6.071) to 20.27 (SD 4.978) in the experimental group (p=0.001), and from 28.40 (SD 5.792) to 27.73 (SD 6.273) in the comparison group (p=0.045). Reported between-group post-test comparisons were statistically significant for WeeFIM and JTHFT (p=0.002 for each).

Conclusion: The findings suggest that adding BTE Primus RS training to conventional occupational therapy may improve hand-function performance and functional independence in this sample. Larger studies with clearly reported allocation procedures, complete effect estimates and follow-up are needed.

Keywords: Baltimore Therapeutic Equipment; cerebral palsy; spastic diplegia; occupational therapy; hand function; activities of daily living; WeeFIM; Jebsen–Taylor Hand Function Test.

1. INTRODUCTION

Cerebral palsy is a group of permanent disorders of movement and posture attributed to non-progressive disturbances in the developing brain. Although spastic diplegia predominantly affects the lower limbs, upper-limb involvement can also affect reaching, grasping, releasing, manipulating objects and coordinated use of the hands. Difficulties in these skills may restrict participation in self-care and other everyday activities.

Occupational therapy addresses functional performance through purposeful activity, repeated practice and intervention tailored to the child's abilities. The Baltimore Therapeutic Equipment (BTE) Primus RS is an evaluation and exercise system that permits practice of movements relevant to grip, pinch, forearm rotation, wrist movement and upper-limb control. The dissertation underlying this manuscript examined whether adding BTE training to conventional occupational therapy was associated with better hand function and daily functional independence than conventional occupational therapy alone.

2. AIM AND OBJECTIVE

The aim was to determine the effect of BTE Primus RS training on hand motor function and activities of daily living in children aged 8–12 years with spastic diplegic cerebral palsy. The specific objective was to compare pre- to post-intervention outcomes between children receiving BTE plus conventional occupational therapy and children receiving conventional occupational therapy alone.

3. MATERIALS AND METHODS

3.1 Study design and setting

The study used a pre-test/post-test, two-group controlled design and was conducted in the inpatient and outpatient services of the Department of Occupational Therapy, National Institute for Locomotor Disabilities (Divyangjan), Kolkata, India. The dissertation describes convenience sampling and also reports allocation to groups by drawing slips. The final journal version should clarify the exact design and allocation method consistently.

3.2 Participants

Thirty children aged 8–12 years with medically diagnosed spastic diplegic cerebral palsy completed the study, with 15 participants in each group. Inclusion criteria reported in the dissertation were: diagnosis of spastic diplegic cerebral palsy; age 8–12 years; GMFCS levels II–IV; Manual Ability Classification System levels I–III; ability to understand and follow verbal commands; and no previous treatment using a BTE work simulator. Exclusion criteria were upper-extremity surgery; associated seizure, psychological or upper-extremity orthopaedic disorders; cognitive or perceptual deficits; involuntary upper-extremity movements; visual or auditory disorders; and current botulinum toxin treatment.

3.3 Intervention

Experimental group: participants received 20 minutes of BTE Primus RS training and 20 minutes of conventional occupational therapy per session. Five attachments were used for approximately four minutes each: pinch tool (151), grip tool (162), round knob (303), cylindrical/D-handle (601), and small lever (701).

Comparison group: participants received 40 minutes of conventional occupational therapy per session. Both groups received three sessions per week for six weeks, for a total of 18 planned sessions and 40 minutes per session.

3.4 Outcome measures

The Wee Functional Independence Measure (WeeFIM) was used to assess functional independence in everyday activities. The Jebsen–Taylor Hand Function Test (JTHFT) was used to assess timed performance on functional hand tasks. Assessments were completed before and after the intervention. For JTHFT, shorter completion times indicate better performance.

3.5 Statistical analysis

The dissertation reports use of SPSS version 25. The Wilcoxon signed-rank test was used for within-group comparisons and the Mann–Whitney U test for between-group comparisons. Statistical significance was set at $p<0.05$ with a 95% confidence interval. Exact confidence intervals and effect sizes were not provided in the material used to prepare this draft.

3.6 Ethical considerations

The dissertation reports that ethical permission was obtained from the Ethics Committee of the National Institute for Locomotor Disabilities, Kolkata, and that written informed consent was obtained. Before submission, please verify the ethics approval reference/number, approval date, consent process for child participants and parent/guardian consent/child assent details, and report them in the format required by the target journal.

4. RESULTS

Thirty participants completed the study (15 per group). The experimental group had a mean age of 9.48 years (SD 1.183), and the comparison group had a mean age of 9.69 years (SD 1.029). Baseline outcome scores were similar between groups according to the dissertation's reported homogeneity analysis.

Baseline characteristic	BTE + conventional OT (n=15)	Conventional OT (n=15)
Age, years, mean (SD)	9.48 (1.183)	9.69 (1.029)
Sex, male:female	11:4	8:7
WeeFIM pre-test, mean (SD)	80.13 (15.142)	78.60 (16.383)
JTHFT pre-test, mean (SD)	29.00 (6.071)	28.40 (5.792)

The baseline comparisons reported no statistically significant group differences for sex (p=0.367), age (p=0.838), WeeFIM (p=0.806) or JTHFT (p=0.775).

Outcome	Group	Pre-test mean (SD)	Post-test mean (SD)	Within-group p-value
WeeFIM	BTE + conventional OT	80.13 (15.142)	102.00 (17.034)	0.001
WeeFIM	Conventional OT	78.60 (16.383)	80.47 (16.522)	0.009*
JTHFT	BTE + conventional OT	29.00 (6.071)	20.27 (4.978)	0.001
JTHFT	Conventional OT	28.40 (5.792)	27.73 (6.273)	0.045

*The p-value is reproduced as reported in the dissertation; it should be checked against the original statistical output before submission.

The dissertation reports statistically significant between-group post-test differences for WeeFIM ($Z=-3.051$, $p=0.002$) and JTHFT ($Z=-3.038$, $p=0.002$). Since JTHFT is a timed test, a lower score represents faster task completion and better performance.

5. DISCUSSION

In this sample, children who received BTE training in addition to conventional occupational therapy showed a larger improvement in WeeFIM scores and a greater reduction in JTHFT completion time than children who received conventional occupational therapy alone. The BTE attachments were selected to practise pinch, grip, rotational grasp, forearm/wrist movement and broader upper-limb movement. Such structured practice may support components of hand use needed during functional tasks; however, the study does not establish which attachment or treatment component was responsible for the observed changes.

The findings are consistent with the clinical rationale for combining task-specific upper-limb practice with conventional occupational therapy. Interpretation should remain cautious because the sample was small, follow-up was not reported, and the dissertation contains inconsistencies in its description of the study design and intervention duration. The reported between-group results would be more informative if accompanied by group-wise change scores, effect sizes and confidence intervals.

6. LIMITATIONS

The dissertation identifies a small sample, limited intervention period, absence of follow-up assessment, lack of onsite home/occupational environment assessment and absence of a home exercise programme. In addition, the manuscript should clarify the sampling and allocation procedures and ensure that all reported p-values and outcome summaries match the original statistical output.

7. CONCLUSION

Within this small controlled pre–post study, adding BTE Primus RS training to conventional occupational therapy was associated with improved WeeFIM scores and reduced JTHFT completion times in children aged 8–12 years with spastic diplegic cerebral palsy. The findings support further evaluation of BTE-assisted upper-limb training, using larger samples, transparent allocation procedures, complete statistical reporting and follow-up assessment.

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