Efficiency of Bobath Approach versus Practice on Gross Manual Dexterity in Children with Hemiparetic Cerebral Palsy

Samia A. Abdel Rahman, PTD.
Department of Physical Therapy for Disturbances of Growth and Development in Children and its Surgery, Faculty of Physical Therapy, Cairo University.

ABSTRACT

The purpose of this study was to investigate the effect of two different treatment interventions, neurodevelopmental treatment (NDT) and practicing of specific functional activity, on improving the gross manual dexterity of the affected upper extremity in spastic hemiparetic cerebral palsied children. Thirty children with spastic hemiparetic cerebral palsy (CP) participated in the study, ranging in age from 4 to 7 years. They were selected from both sexes. Gross manual dexterity was examined by the use of Box and Block test (BBT), which was performed before and after one month of intervention. The subjects were randomly divided into two groups of equal number. Group (I) received NDT and group (II) received practice of BBT (which was used as an activity for this group). The two groups were treated 6 days per week for one month. The results of the study revealed an improvement in the post-BBT in group (I) with no significant change in group (II), indicating the effectiveness of NDT in improving gross manual dexterity of the affected upper extremity in spastic hemiparetic CP.

Key Words: Child development; Cerebral palsy; Hemiplegia; Manual dexterity; Neuro-developmental treatment; Practice; Test and measurements.

INTRODUCTION

Manipulative movement includes both gross and fine motor manipulation. The gross one involves imparting force to, or receiving force from objects such as during throwing while the fine motor manipulation involves intricate use of the muscles of the hand and wrist such as during typing. The authors stated that the most basic aspects of manipulation are reaching, grasping and releasing. Reaching requires the involvement of the lower extremities and trunk during its execution. There are two hand uses; 1) extrinsic hand movements in which the object is held firmly by the fingers in the palm (gross manual dexterity) and 2) intrinsic hand movements in which the object is held in the hand itself (fine manual dexterity).

There are different types of CP. Spastic CP is the most common motor impairment type accounting for 70% to 80% of all CP cases. Approximately 35% to 40% have spastic hemiplegia. The spastic hemiplegic CP infants showed deficient forward movement of the arm and deficient opening of the hand on the affected side which intern affect their performance in gross as well as fine manual dexterity. Children with hemiplegic CP have a number of difficulties when reaching and grasping such as slowness.
in speed of the affected limb, delay in the reaching initiation, slowness in flexing the fingers to grasp, overextension of the fingers, weak grasp as well as flexion of their wrist towards the object which disrupts the wrist fixation\textsuperscript{30}.

The major concept of the NDT is based on a conclusion that a lesion of the central nervous system (CNS) results in a loss of movement and not in a paresis of muscles. Furthermore, new motor skills are learned by learning movement patterns and not a sequence of a mosaic of activation of specific muscles. Therefore, in learning new motor skills, the focus is mainly on the coordination of movement patterns and their accompanying postures\textsuperscript{3}. The NDT has traditionally been the intervention of choice when treating children with CP. It is widely accepted treatment approach with emphasis on the neurological aspect of movement disorder. Normal postural responses and active movements are facilitated through the use of special handling techniques, while abnormal movement patterns and muscle tone are inhibited. One of the goals within the NDT is to facilitate repeated active movements involving postural control and functional goals, which may result in improved coordination and strength\textsuperscript{1}.

During the learning process, the learner is discovering relevant problem-solving strategies and the movement behavior is gradually refined toward a functional optimum one that minimizes work and maximizes goal accomplishment. If motor learning is viewed as problem solving and is context-dependent, an increasingly skillful, efficient movement behavior to evolve with the number of repetitions would be expected\textsuperscript{19}. Practice, often defined as a number of repetitions, is considered the key ingredient for learning motor skills. Appropriate practice has been shown to lead to improved motor performance\textsuperscript{7,25}.

Children with CP have different resources for resolving a task, yet they seem able to organize what resources they have in interacting with the environment and solving specific problems\textsuperscript{12}. They also seem able to make changes in quality of movement with practice\textsuperscript{13}. Movement can become smoother and more skillful, achieving the goal with less effort\textsuperscript{22}. In individuals who are not disabled, the degree of contraction can be modified and the accuracy of muscle activation could be increased through practice. Children with CP may be able to make changes in variables that affect their control on manual performance, such as force production and abnormal sequencing of muscle activation, with skilled-specific training\textsuperscript{8}. Motor learning strategies, such as extensive practice can be applied to improve the quality of movement in children with CP\textsuperscript{7,14}.

Practice of a task and NDT are therapeutic approaches often implemented in treatment of children with CP. More empirical data are needed to establish the effectiveness of these different treatment approaches on the gross manual dexterity in children with CP. The purpose of the present study is to contrast the two types of interventions and measure their effects on gross manual dexterity. The study assessed the effect of two treatment intervention, NDT and practice, on performance of the affected upper extremity in the box and block test in children with spastic hemiparetic CP.

**SUBJECTS, MATERIALS AND PROCEDURES**

**Subjects**

Thirty children with spastic hemiplegic cerebral palsy participated in the study. They
were randomly selected from both sexes (18 boys and 12 girls). Their ages ranged from 4 to 7 years. Subjects were recruited from the physical therapy department in the public hospital of Hawamdia, Giza. Subjects were included if they 1) were able to understand and carry out spoken directions included in the procedures, 2) had sufficient visual skill to localize an object with both eyes and 3) had sufficient passive range of motion in the affected upper limb to be able to reach the target used in the reaching task described in the materials.

Subjects were excluded if they 1) had any associated disorders such as visual and hearing defects, perceptual defects and/or visuomotor defects, 2) were not regularly participated and treated on the base of daily session for one month, 3) had hyperactivity that interfered with their ability to sit quietly during evaluation and/or during treatment procedures and 4) had inability to sufficiently open the hand of the affected upper extremity to grasp the blocks used in the box and block test.

Subjects were divided into two equal groups (I and II). Group I included 10 boys (9 right sided and 1 left sided) and 5 girls (3 right sided and 2 left sided). This group received the NDT. Group II included 8 boys (5 right sided and 3 left sided) and 7 girls (3 right sided and 4 left sided). This group received practice (practicing the box and block activity). The degree of spasticity was determined according to the modified Ashworth scale to be within the range of 1, 1+ and 2 grades.

Materials

Box and Block Test (BBT) was used to evaluate gross manual dexterity of the affected upper extremity for both groups as well as for practicing for group (II). This test was used as a reliable and valid test in measuring unilateral gross manual dexterity. The test has the advantages of 1) being easily constructed at a reasonable cost, 2) being simple so that it is appropriate for evaluation of manual dexterity of patients with low intelligence and/or limited manual dexterity, 3) being administered in sitting position that is appropriate for those have difficulty to stand and 4) being used to evaluate the effectiveness of treatment programs designed to improve gross manual dexterity.

Test-retest reliability for BBT was established at a one-month interval and found to be high (r = 0.93 and 0.97) for the left and right hands, respectively. The Box is constructed of 1 cm of plywood. The outside dimensions of the box are 53.7 cm by 25.4 cm. The long sides of the box are 53.7 cm by 8.5 cm and are nailed to the 1 cm thickness of the base. The short ends, 7.5 cm by 25.4 cm, are nailed to the top of the base between the long sides. The box is divided into two 25.4 cm square compartments by inserting a partition in the center. This partition is 25.4 cm long, 15.2 cm high and 1 cm thick. Near the top of the partition, two 2.5 cm holes are drilled for ease in transporting. The bottom of the box (inside) is padded to decrease the noise during testing (Figure 1A). The blocks are 100 colored wooden cubes 2.5 cm square. For the blocks, a storage box of 1 cm of plywood is made with inside dimensions of 15.2 cm square and 20.3 cm high (Figure 1B). This shape facilitates the pouring of the blocks during the test procedure and also allows for storing the box when the test is not in use. The box and block test was used as a therapeutic tool to improve gross manual dexterity for group (II).
A digital stop watch was used to calculate the time of the performance of the BBT. A modified Ashworth scale was used to measure the degree of spasticity for all subjects before the beginning of the treatment. A chair with suitable height and a back support as well as a single cut-out table with a suitable height were used for the evaluation with the BBT and for practicing the BBT for children in group (II). Mat, roll, wedge and a therapeutic ball were used for the application of the NDT.

**Procedures**

Each child was sitting facing the cut-out of the single cut-out table. The box used for BBT was fixed by an adhesive plaster to the surface of the table (to prevent its movement during the child’s performance). The box was placed against the middle of the child’s trunk and away from the table’s edge by about 10 cm. The blocks were inside one of the two compartments of the box, which was on the side next to the child’s tested or practiced hand.

The examiner was sitting facing the child to be able to view the blocks being transported to the other compartment of the box. Three-minute trial period preceded the test. Immediately before the test, the child was asked to place his/her hands on the sides of the box. On signal, the child grasped one block at a time with the tested upper extremity, transported the block over the partition, and then released it into the opposite compartment. By the use of a stopwatch, the child was asked to stop after 10 minutes. After testing, the examiner counted the number of the transported blocks. No penalty was made if the child transported any block across the partition and the block bounced from the box to the floor or table. The following directions were given to each child. "I want to see how you can pick up one block at a time with your right (or left) hand (the examiner will point to the hand). Carry it to the other side of the box and drop it. Watch me while I show you how". The examiner then transported about three blocks over the partition in the same direction that the child had to move them. After demonstration, the examiner said the following instructions. "If you pick up two blocks at a time, they will count as one. If you drop one on the floor or the table after you have carried it across, it will be counted, so do not waste time picking it up. If you toss the blocks without your fingertips crossing the partition, they will not be counted. Before you start, you will have a chance to practice for three minutes. Do you have any questions? Place your hands on the side of the box. When it is time to start, I will say ‘ready’ and then ‘go’".

The stopwatch started at the word go. After three minutes, the examiner said ‘stop’.
If any mistakes occurred, they were corrected before the actual test. On completion of the practice period, the transported blocks were returned to the compartment. The examiner then mixed the blocks to assure random distribution. The examiner continued with the following directions.

This will be the actual test. The instructions are the same. Try to transport a large number of blocks as much as you can. Ready, [the examiner will wait 3 seconds] Go. [After 10 minutes] Stop. [Counting will be recorded as described above]. The score was the number of blocks that were successively carried across the partition in 10 minutes.

The study included both evaluation and treatment procedures. The evaluation included 1) evaluation of the degree of spasticity for the affected upper extremity before and after one month of treatment for both groups and 2) evaluation of the performance of the BBT using the affected upper extremity before treatment as well as after one month of treatment for both groups. Treatment included NDT for group (I) and practicing of BBT as an activity for group (II). Treatment was given daily on the basis of 6 sessions per week for one month (a total of 24 sessions). The session for both groups continued for 55 minutes on the basis of 10 minutes treatment followed by 5 minutes rest.

**RESULTS**

The statistical analysis were conducted on 30 spastic hemiparetic cerebral palsy children (20 right and 10 left sided). The children were 18 boys and 12 girls; their ages were ranged from 4 to 7 years. The degree of spasticity was ranged from 1 to 2 grades (Table 1).

The paired samples t-test was used to analyze the collected data in group (I) as well as in group (II). The test showed significant difference between the number of blocks \((p < 0.001)\) after one month of NDT in group (I) (Table 2 and Figure 2). The paired samples t-test showed no significant changes between the number of blocks after one month of practice \((p > 0.05)\) in group (II) (Table 3 and Figure 3).

**Table (1): General characteristics of the study groups.**

<table>
<thead>
<tr>
<th>Subjects</th>
<th>Side of Lesion</th>
<th>Age (Year)</th>
<th>Spasticity (Grades)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Right</td>
<td>Left</td>
<td>Mean</td>
</tr>
<tr>
<td>Group (I)</td>
<td>Boys</td>
<td>9</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Girls</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>12</td>
<td>3</td>
</tr>
<tr>
<td>Group (II)</td>
<td>Boys</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Girls</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>8</td>
<td>7</td>
</tr>
<tr>
<td>All Subjects</td>
<td>Boys</td>
<td>14</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Girls</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>20</td>
<td>10</td>
</tr>
</tbody>
</table>


**Table (2): Number of blocks for group (I).**
Mean  

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>SD</th>
<th>Min.</th>
<th>Max.</th>
<th>t-Test</th>
<th>t-Tabulated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Measure</td>
<td>16.33</td>
<td>±2.44</td>
<td>13</td>
<td>20</td>
<td>2.76</td>
<td>2.15*</td>
</tr>
<tr>
<td>Post-Measure</td>
<td>27.67</td>
<td>±3.70</td>
<td>23</td>
<td>34</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

SD: Standard Deviation.  
Min.: Minimum.  
Max.: Maximum.  
*t-Tabulated at 0.05.

*t-Test: Paired sampled t-Test value.

![Fig. (2): Number of blocks in group (I) before and after one month of NDT.](image1)

Table (3): Number of blocks for group (II).

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>SD</th>
<th>Min.</th>
<th>Max.</th>
<th>t-Test</th>
<th>t-Tabulated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Measure</td>
<td>16.67</td>
<td>±2.74</td>
<td>13</td>
<td>21</td>
<td>1.77</td>
<td>2.15*</td>
</tr>
<tr>
<td>Post-Measure</td>
<td>20.60</td>
<td>±3.27</td>
<td>16</td>
<td>27</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

SD: Standard Deviation.  
Min.: Minimum.  
Max.: Maximum.  
*t-Tabulated at 0.05.

t-Test: Paired sampled t-Test value.

![Fig. (3): Number of blocks in group (II) before and after one month of practice.](image2)

Two samples t-test was then used to compare between the number of blocks in group (I) and (II) before as well as after one month of intervention. The test showed that before intervention, there was no significant difference ($p > 0.05$) between the number of blocks for group (I) and (II) (Table 4 and Figure 4). However after one month of...
intervention, the two samples t-test represented a highly significant difference \( p < 0.0001 \) between the numbers of blocks for groups (I) and (II) (Table 5 and Figure 5).

**Table (4): Number of blocks for groups (I) and (II) before intervention.**

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>SD</th>
<th>Min.</th>
<th>Max.</th>
<th>t-Test</th>
<th>t-Tabulated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group (I)</td>
<td>16.33</td>
<td>±2.44</td>
<td>13</td>
<td>20</td>
<td>0.73</td>
<td>2.15*</td>
</tr>
<tr>
<td>Group (II)</td>
<td>16.67</td>
<td>±3.74</td>
<td>13</td>
<td>21</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

SD: Standard Deviation. Min.: Minimum. Max.: Maximum. *t-Tabulated at 0.05.

t-Test: Paired sampled t-Test value.

**Fig. (4): Number of blocks in groups (I) and (II) before the beginning of the program.**

**Table (5): Number of blocks for groups (I) and (II) after one month of intervention.**

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>SD</th>
<th>Min.</th>
<th>Max.</th>
<th>t-Test</th>
<th>t-Tabulated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group (I)</td>
<td>27.67</td>
<td>±3.70</td>
<td>23</td>
<td>34</td>
<td>6.30</td>
<td>2.15*, 2.98&quot;</td>
</tr>
<tr>
<td>Group (II)</td>
<td>20.60</td>
<td>±3.27</td>
<td>16</td>
<td>27</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

SD: Standard Deviation. Min.: Minimum. Max.: Maximum. *t-Tabulated at 0.05.

t-Test: Paired sampled t-Test value.

**Fig. (5): Number of blocks in groups (I) and (II) after one month of treatment.**
DISCUSSION

The purpose of this study was to compare between the effects of NDT and practice on the gross manual dexterity of the affected upper extremity in spastic hemiparetic cerebral palsied children. The performance of the children in the box and block test using the affected upper extremity was the measured variable (the number of the transferred blocks).

The results of the study revealed an improvement in the box and block test for the children in group (I) (the group who received NDT). The improvement noted after NDT supports the assumption that NDT is successful in improving upper extremity functions in children with CP.

The functional task of reaching, which is required to perform the box and block test, requires appropriate postural support to ensure that the arm and hand successfully reach the intended goal. Postural muscle activation precedes and in same cases occurs simultaneously with arm movement during reaching tasks in sitting position. By adjusting posture, secure balance is ensured during the execution of particular task. Individuals with CP often have poor postural control and consequently shift their posture as little as possible. In this way, diminished balance or postural control may be an underlying constraint on successful, efficient accomplishment of a functional task such as reaching.

The main changes in postural control after NDT were increased midline head control, decreased neck hyperextension, decreased scapular retraction, increased trunk symmetry and a more erect trunk posture in children with CP. These changes may be the underlying causes for the improvement seen in the performance of the affected upper extremity in group (I) in this study.

Another possibilities for the noted improvement in group (I) may include an alteration in muscle strength, agonist/antagonist relationship, timing and sequence of muscle activities, muscle tone, muscle stiffness and other mechanisms that influence motor behavior.

The results noted in group (II) (the group who received practice) might be due to fatigue, because there was no change in their position during practice. Children with CP have increased metabolic costs and fatigue easily, requiring longer rest periods after activity than children without disabilities. The NDT may be more appropriate for promoting immediate effects after treatment, whereas practice might need more time and repetition of the appropriate task to be effective.

This study supports the results obtained by Mayo (1991) who found an improvement in postural reactions, motor ability and motor skills as well as in the ability to participate in activities of daily living after intensive NDT for children with CP. The study is also supported by a work of Kerem et al., (2001) who investigated the effectiveness of home exercise program (HEP) based on Bobath NDT in CP on motor development. The pre and post HEP motor development scores of the study group were compared and a significant difference was found in favor of the post HEP results (p < 0.05). The obtained results come in agreement with the results of Knox and Evans (2002) who evaluated the functional effects of Bobath therapy in children with CP. The participants were tested with the Gross Motor Function Measure (GMFM) that revealed a significant improvement in the total scores (p = 0.009).

On the contrary, the results of this study disagree with the results obtained by Law et
al., (1997) who studied the effect of combined intensive NDT and casting comparing to less intense occupational therapy (OT) in improving hand function and quality of movement in children with CP. The authors revealed no significant difference in hand function, quality of movement or parents' perception of hand function performance between the two treatment groups- intensive NDT plus casting and regular OT program.

Conclusion

It can be concluded that NDT has an improving effect on the performance of the affected upper extremity in spastic hemiparetic cerebral palsied children when comparing it with practice. A prolonged time of practice may be required to reveal a significant improvement in the performance of the affected upper extremity in gross manual dexterity in children with hemiparetic CP. Further study may be required to investigate the combined effect of both NDT and practice on children with CP.

REFERENCES


فعالية طريقة بوباس مقابل الممارسة العملية على البراعة اليدوية لدى الأطفال المصابين بالشلل المخي النصفي

هَدَّف البحث إلى دراسة تأثير طريقتين مختلفتين من طرق العلاج الطبيعي وهم طريقة العلاج العصبي التطوري (طريقة بوباس) وطريقة التدريب أو الممارسة العملية على تحسن البراعة اليدوية في الطرف العلوي المصاب لدى الأطفال المصابين بالشلل المخي النصفي التشنجي. تم إجراء البحث على 30 طفلاً من الأطفال المصابين بالشلل المخي النصفي التشنجي من الجنسين. تتراوح أعمار الأطفال من 4 إلى 7 سنوات. تم اختيار الباعة اليدوية لدي الطرف العلوي المصاب باستخدام اختبار الصندوق والمكعبات وذلك قبل إعطاء البرامج العلاجية.

بعد شهر من العلاج المكثف، تم تقسيم الأطفال إلى مجموعتين متساويتين حيث تلتقت المجموعة الأولى العلاج العصبي التطوري وتم تقسيم المجموعة الثانية طريقة العلاج بالتدرّب باستخدام الصندوق والمكعبات لمدة شهر (٢٠ أيام أسبوعيًا). أظهرت النتائج وجود تحسن ذو دلالة إحصائية عالية في أداء الأطفال في المجموعة الأولى باستخدام الصندوق والمكعبات بينما لم يحدث تحسن معنوي في المجموعة الثانية. تشير هذه النتائج إلى فعالية العلاج العصبي التطوري في تحسين البراعة اليدوية للطرف العلوي المصاب لدى الأطفال المصابين بالشلل المخي النصفي التشنجي.