

# Postural Control as Prerequisites of Handwriting for Children with Spastic Cerebral Palsy

Riksma Akhlan, Endang Rochyadi and Sunardi Sunardi

*Special Education Program, Universitas Pendidikan Indonesia, Jl. Dr. Setiabudhi No. 229 Bandung, Indonesia  
riksma\_akhlan@upi.edu*

**Keywords:** Cerebral Palsy, Control Posture, Handwriting Readiness, Psycho Rehabilitative Intervention Program.

**Abstract:** Children with cerebral palsy shows wide range syndromes of brain disorder related with the motor skills function in activity, physical, and balance limitations. This study reports postural control which includes body awareness in sitting position and movement of hand and arms in handwriting readiness for children with spastic cerebral palsy. A psycho rehabilitative approach was used as an intervention program to improve the child's basic motor skills. Experiment was conducted in a single subject research with spastic cerebral palsy at age of 6 years old. Pre-test and post-test were designed to see intervention effect on stability in stroking the line and quantity of the stroked lines. Results showed improvement in stability of stroking the lines after six session of intervention. However, the quantity of the stroked line did not meet the expected number. In conclusion the postural control using psycho rehabilitative intervention approach affect handwriting readiness. Further research is needed to define other factors that may be contributed to the ability of making a number of expected lines when the stability has actually achieved. This psycho rehabilitative approach also need to be further conducted in a classroom setting with a longer period of time and a more subject included.

## 1 INTRODUCTION

All activities in live involve motor skills function. Postural control and stability are the prerequisites in doing movement task functionally (Hong, 2002). Inability to control posture will significantly have effect on motor skills function achievement (Hong, 2002; Santos et al., 2010; Shumway and Woollacott, 2012; Saether et al., 2013). Children with cerebral palsy are enduring brain disorder syndromes related to the motor skills function (Miller, 2007), movement development, posture and balance, which are causing restriction in their activity. These disorders are non-progressive and happen during infant or baby. As a result, some approaches like stimulation, motor skills intervention and rehabilitation become an inseparable part of the children life. There are abilities that need to be trained, such as ability to maintain a current physical condition, delay contracture and reduce stiffness (Gilinsky and Smith, 2005; McClinton, 2007). Intervention towards postural control is also significant in preparing special function (Hong, 2002).

However, not all activities in stimulation program can improve its physical activity (van Wely et al., 2014). Thus, conceptual construction in controlling motor system, motor learning (Howe et al., 2013) and stimulation of development strategy in improving daily function are of importance.

The first research objectives are to observe the ability of children with Cerebral palsy spastic hemipleg in stroking lines and drawing lines as prerequisite in handwriting abilities. The second objective is to determine whether the given intervention could improve the prerequisite handwriting abilities in both striking lines and drawing circle. This determines of prerequisites abilities is important before we could teach / give a handwriting lesson to the children. The ability in stroking lines is in line with stability in movement execution that requires muscle strength and posture control. This research was conducted by combining few approaches, i.e. the psycho rehabilitative approach as an intervention and the stimulation children activity as an active participant using instruction. The instruction was given to lead the child's understanding of postural control and body awareness on doing basic motor skills in arm hand

skilled movement and sitting position stability. Those skills are the prerequisites in handwriting.

Writing is an essential activity for children and a challenge to majority of students, especially those who have motor skills dysfunction. Writing ability is one of the academic tasks that has function to remember, to process information and to communicate thought and ideas (Naider-Steinhart and Katz-Leurer, 2007). Writing is a complex motoric activity. It requires a number of prerequisite skills, such as good postural control (Donica et al., 2013). It needs motoric planning and hand mastery, which is quite dominantly (Benbow et al., 1992). The activity requires visual discrimination, perception organization (Tükel and Eliasson, 2011) and cognition (Feder and Majnemer, 2007). It also involves language processing (Kurtz, 2008) and executive functions (Hooper et al., 2002; St Clair-Thompson and Gathercole, 2006). Writing is more comfortable when position and posture are in the sitting position with the head postural control (Wandel, 2000), rather than in the standing position (Howe et al., 2013). Perceptually good sitting posture is a straight posture that developed three dimension of space and distance awareness. Comprehension about surrounding will get better when the head, eyes and ears are in a straight position, as well as social interactions that are mostly conducted in a straight position.

As not all activities in stimulation program can improve physical activity, the construction needs to be focused on special needs of each child based on its required development. In Japan, stimulation and intervention program named as *dohsa-hou* is one of a psycho rehabilitative intervention approaches. This approach has been used in helping children to understand themselves in executing their motoric activity (Naruse, 1997; Dadkhah and Harizuka, 2002; Konno, 2016). In South Australia, conductive education has been used to support children and adults with physical and multiple disabilities, with assumption that motor disorders are learning disabilities. Conductive education involves the role of class leader known as conductor, teaching strategies known as rhythmic intention, task series and described equipment, and the structured program. (Bourke-Taylor et al., 2007) describes the importance of the group setting, the impact on motivation, and the development of self-efficacy within each child in this type of education. Other combination programs, such as a sensory motor program that combined with an occupational therapy treatment have shown a significant changed in component function for improving handwriting

readiness skills (Oliver, 1990). A different method on teaching handwriting with instruction or instructional condition has also been able to show an enhanced legibility and fluency in better writing performance (Santangelo and Graham, 2016). However, those mentioned research were solely conducted in its own approach.

## 2 METHODS

Experiment was conducted with a single subject research using the A/B design which purposively chosen. This experiment was taken place in Centre of Assessment and Intervention for Children with Special Needs, Universitas Pendidikan Indonesia, Bandung, from February to August 2015. Individual analysis was assessed to a 6 years old child with spastic cerebral palsy at the first grade of Special School. Participant assessment was directed by a pretest-posttest design. The pre-test was defining a baseline of the child's handwriting readiness. Six times pre-test was conducted until the child showed a consistent handwriting readiness skills before it was given a psycho rehabilitative intervention.

Intervention of postural control on body awareness in sitting position, hand and arms movement using psycho rehabilitative approach was given in six sessions within 4 hours per week through learning process and playing activity where child as an active participation. The skills were including (1) positioning the upper extremity and postural head control, (2) reach, (3) grasp, (4) hold, (5) release, (6) manipulate, (7) push/pull/shove, (8) displace/Lift, (9) fixate as described in Lemmens (2014) (10) pelvic stability, and (11) leg and foot positioning as described in Wendel (2000).

During six session of intervention, the child was given a series of stroking line intervention sheet as presented in Figure 1. Five different sheets were given to the child gradually in proportion to the child's ability in stroking the lines. The more progress the child made, the more complex sheet was given to the child. At the beginning of the session, the child was only given the sheet number 1 (Figure 1). This work on sheet number 1 was continued at the session two. At the session three, the child was started to work on sheet number 2 and number 3 (Figure 1). At the session four, five and six, the child was gradually working on sheets number 3, 4 and 5 (Figure 1), respectively.

In each session, the intervention of postural control given to the child was focused on its motor skills that affect handwriting readiness as described

in Donica et al. (2013). The handwriting readiness was assessed by indicators in stability to stroke a line and the expected quantity of the stroked line as exemplified in previous research (Tükel and Eliasson, 2011; van Hartingsveldt et al., 2011; Santangelo and Graham, 2016).

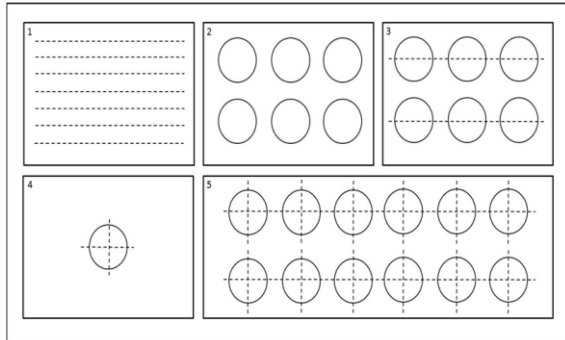


Figure 1: A series of stroking line intervention sheet.

### 3 RESULTS AND DISCUSSION

The pre-test was aimed to measure the child’s handwriting skills in making a stroke line with stability and to quantify the stroked-lines that was made in six repeatable times. The result showed that the child was not able to make a stroke line and stability was not evident when making the stroked lines. The child was able to hold a utensil, i.e. a pen, but did not have enough strength to make a stroked line with its pen. Thus, psycho rehabilitative intervention was introduced to improve child’s basic motor skills. This intervention was conducted in six sessions to stimulate the ability in making stroke lines.

At first session of intervention, the child showed an ability to hold the writing utensil. The child was given an intervention in acknowledging the most comfortable utensil to be used in making stroked line, and was encouraged to have enough strength to push the utensil into the paper. Stability and the expected quantity of the stroked line were not shown in this session. At second session of intervention, stability was started to appear when the child stroked a straight line in sheet number 1 (Figure 2. First and Second Session sheet number 1). However, the quantity of the stroked line was not fulfilled assessment criteria.

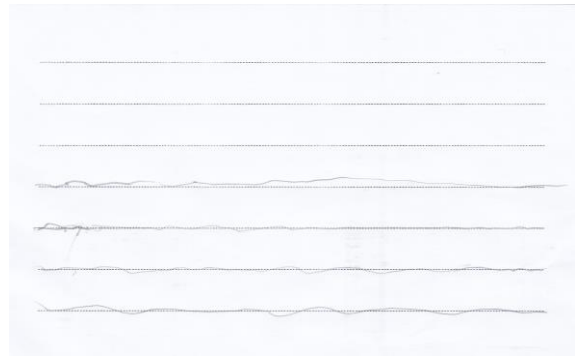


Figure 2: First and Second Session sheet number 1.

Improve child’s motor skills started to show at the third session of intervention. Here, the child has found comfort in holding the pen and was able to stroke the line consistently. It was able to thickening the points of the straight line in the sheet number 3, but it struggled to make a circle in the sheet number 2 and sheet number 3 (Figure 3. Third Session sheet number 2 and Figure 4. Third Session sheet number 3). From stability perspective, the child has made improvement in stroking a straight line. The stroke lines were not jagged sharply in distant-wise. They also closely stroke to the targeted line. The end result of the stroking lines was started to match the targeted line.

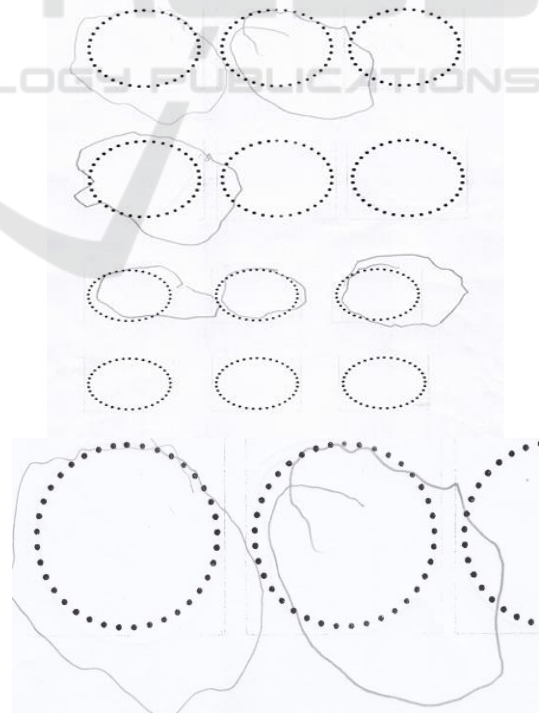


Figure 3: Third Session, Sheet number 1.

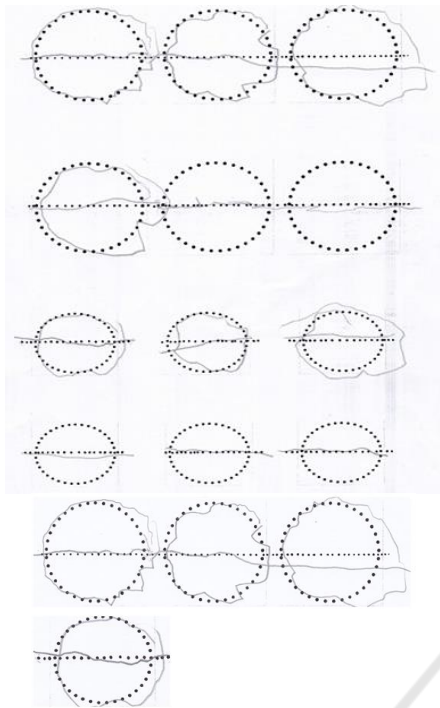


Figure 4: Third Session, sheet number 3.

At the fourth session intervention, the ability to stroke a line in a circle shape was started to show. However, the line was not in a full circle. The constant stability in the straight line showed by the minimal jagged when stroking the line and when it was achieved 50% of the stroked line targeted quantity (Figure 5. Fourth Session sheet number 3).

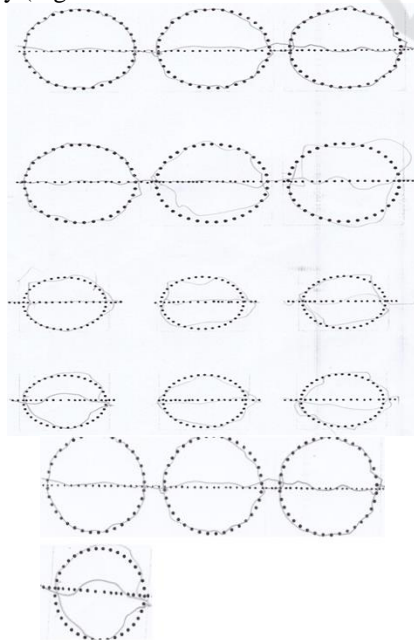


Figure 5: Fourth Session sheet number 3.

At the fifth session, stability of intervention in stroking the lines has fulfilled all required target. However, the quantity of the stroked lines was not achieved as expected. It was still about 50% achievement (Figure 6. Fifth Session sheet number 4 and Figure 7. Fifth Session sheet number 5).

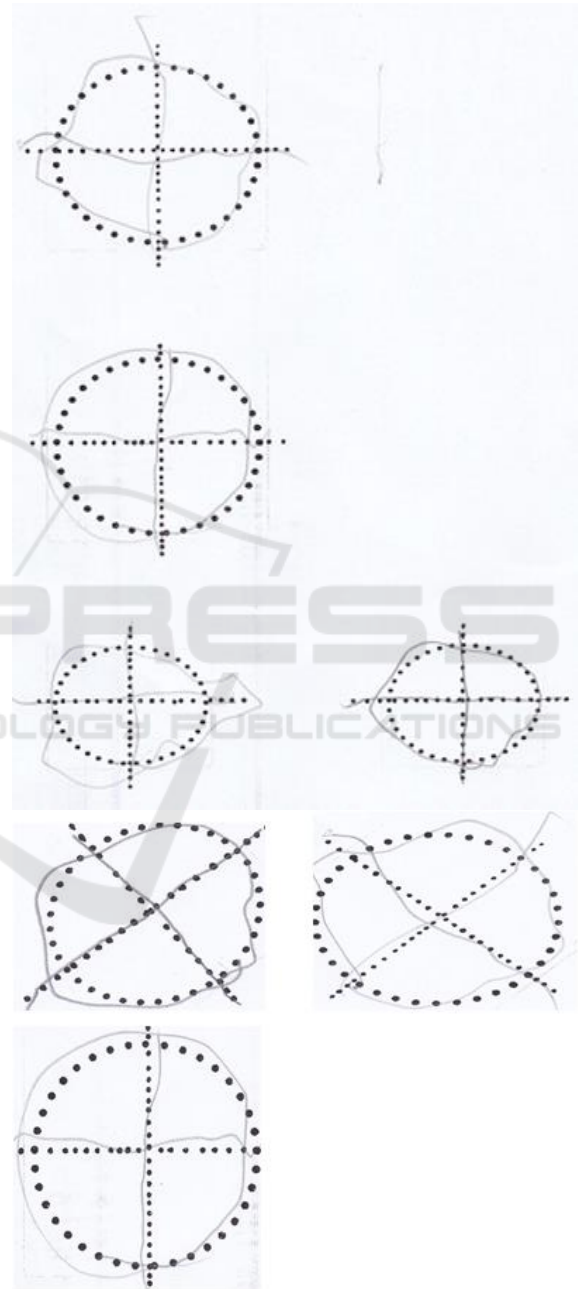


Figure 6: Fifth Session sheet number 4.

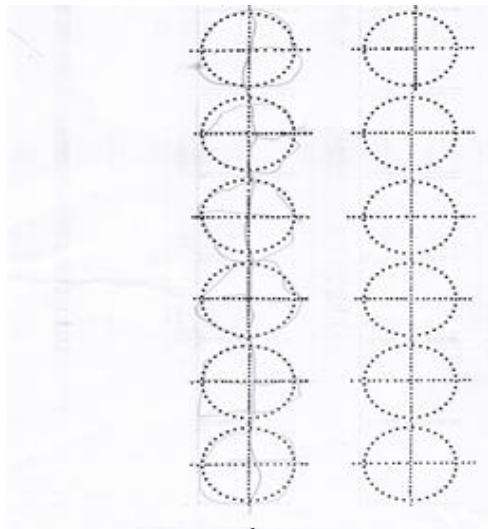


Figure 7: Fifth Session sheet number 5.

At the last intervention, stability was continue fulfilling the target. However, the quantity of the stroked lines was still not achieved as required at more than 75% (Figure 8. Sixth session sheet number 5)

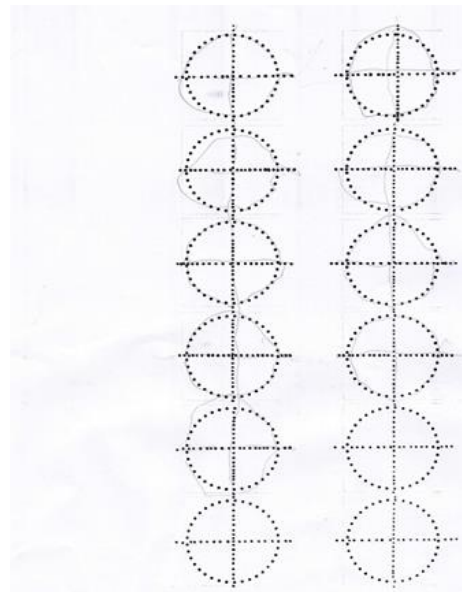


Figure 8: Sixth Session sheet number 5.

The summary of this result is presented in Table 1. Progress Score Handwriting Readiness.

Table 1: Progress Score Handwriting Readiness.

Handwriting Readiness	Baseline	Intervention					
		I	II	III	IV	V	VI
Stability (a)	0	1	1	2	2	3	3
Quantity (b)	0	0	1	2	2	2	2

Handwriting readiness indicators are : (a) stability in stroking a line, and (b) a quantity of the stroked line.

Stability score means: (1) stroking line at any place and not as shaped as the targeted shape, (2) stroking the line with jagged sharply and shaped as the targeted shape, (3) stroking the line without jagged, line as straight as the targeted shape, and stroke in no distance or close to the target.

Quantity score means: (1) making a straight stroke line and circling 20 % of the targeted shape, (2) making a straight stroke line and circling 50% of the targeted shape, (3) making a straight stroke line and circling more than 80% of The targeted shape.

#### 4 CONCLUSIONS AND RECOMMENDATION

Writing readiness in children with cerebral palsy is really depend on their postural control skills, i.e. the ability to understand body awareness, the ability to plan movement and the ability to function in their activity. Intervention with the psycho rehabilitative approach has been proven in helping children with spastic cerebral palsy. It helped organizing the stability of stroking the lines and enabling to achieve the required-quantity of the stroked-lines. However, stability in stroking the lines were not hand in hand with the produced line numbers. A further research is needed to observe whether there were other factors influencing postural control. The complexity of making different types of stroking lines (e.g. making a combination of vertical and horizontal stroking lines and circle at one assignment) may possibly influence the ability of the children in producing certain numbers of the stroking lines. It was also possible that the child was experiencing tiredness when they were making more complex stroking lines. Psycho rehabilitative intervention has also functioned in keeping the movement of muscles and joints, this shows in the progress of stability in stroking lines. The function of motor skill activity could keep maintained. To make sure that the motor skills activity was functioned, the research needs to be observed in a longer period of time. A thorough observation would also be necessity in the development of children with cerebral palsy. Combining a rehabilitation approach with the ability in postural control was a strategy in helping children with cerebral palsy in conducting certain motor skills activity. By way of a will power and effort from the child, children with cerebral palsy can no

longer be a passive recipient of the therapy but an active participant in learning process.

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