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The Effectiveness of Adaptive-Dynamic Sitting Position on Writing Skills of a Student with Moderate Spastic Diplegia due to Cerebral Palsy: A Case Study

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How is dynamic-adaptive seating affecting the writing skills in children with moderate Spastic Diplegia due to Cerebral Palsy? What is the effect of improved sitting posture and/or postural control on participation and functional performance of classroom's activities in children with Cerebral Palsy? In this study a change in the position of the center of gravity of the upper trunk, relative to the sitting base, had a significant effect on the upper extremities function. The results of this study suggest that the use of dynamic seating will benefit children with Cerebral Palsy and other neurodevelopmental conditions as well as maximize their potential for learning and participation in life. The purpose of this case study was to determine the effectiveness and efficacy of dynamic and adaptive seating on the writing skills of a high functioning child with moderate Spastic Diplegia due to Cerebral Palsy (CP).

Management and treatment of children with physical impairments is a major concern not only to pediatrics, neurologists and orthopedists but also to therapists, teachers and parents. According to Rhoda Priest Erhardt (1994) the prehension area, in particular, has received more attention because of the importance of hand use for intellectual growth and independence in self-help skills. How we sit affects what happens when we eat and drink as it affects the cooperation between the head, arms and hands (Bergerson & Larsson, 2009). According to this statement there must be a link between functional seating, the prehension and the writing skills.

Dysfunctional postural control is one of the key problems in children with Cerebral Palsy (CP), which interferes with the activities of daily life (Brogren, HaddersAgra, & Forssberg, 2001; Van der Heide, 2004; cited in De Graaf-Peters et al., 2007). Moreover Carlberg and Hadders-Algra (2005) stated that postural problems play a central role in the motor dysfunction of children with CP, while they exhibit muscular activity counteracting forces that disturb equilibrium. Remarkably, the development of postural adjustments in sitting position is characterized by the absence of antagonistic co-activity (cited in De Graaf-Peters et al., 2007). Pre-school and school-age children with CP always show dysfunctions in the fine tuning of the postural adjustment, i.e., an invariable recruitment order, an excessive degree of antagonistic co-activation during external perturbations, and a reduced capacity to modulate postural adjustments (De Graaf-Peters et al., 2007).

Children with Cerebral Palsy due to abnormal muscle tone present abnormal patterns of movement limiting the quantity and quality of their movement ability. The tone in a patient with spasticity changes with excess as well as a person with typical muscle tone (Bobath, 1990). Berta Bobath additionally explains that "In the patient with spasticity, increase of tonus due to excitation and effort results in stereotyped abnormal patterns of spasticity, which are long lasting due to after-contraction. After-contraction is due to lack of inhibition and plays a detrimental role in the performance of repetitive movements". (p.12)

Thus, children with CP are in greater need of proper seating than most other people with disabilities since they spend a large portion of each day seated, have limitations in other alternative positions and low ability in moving around effectively. Even those high functioning children can be helped with an adaptive or dynamic seating system. "The specialized seating systems do provide the benefits of improved functions, more comfort, easier communication, better interaction with peers, opportunities in formal education, and better prospects for independent movement" (Al-Turaiki, 1996, p.335).

Case Study: Maria

This case study examined how the adaptive, dynamic sitting position affected the writing skills of a 5-year-old, left-handed girl with Cerebral Palsy who was a student in a general pre-primary school in Cyprus. She has a medical diagnosis of Moderate Spastic Diplegia due to Cerebral Palsy. She uses eye glasses due to strabismus and hypermetropia. Because of her prematurity and low birth weight, M. had delayed development. Despite that, she was able to walk independently at 3 and 1/2 years old and the development of her upper limbs was quite typical. M. now presents bilateral spasticity of the legs greater than in the arms and greater in the right side than the left one. She walks indoors and in small distance outdoors independently with a flexion pattern of all the limbs. Her hips are slightly internally flexed and only her right foot is on her toes. In trying to keep her balance against gravity, she externally rotates her shoulders, and flexes her elbows and wrists. Despite good trunk and head control, she has a lack of rotation of the trunk and deficient dissociation between the limbs. In a sitting position, her trunk is hypotonic and flexed due to the posterior tilt of her pelvis, and both shoulders are internal rotated with the elbows flexed. The lower limbs will rest on the floor in a flexed pattern if there is no effort needed from the upper body.

To evaluate the impact of adaptive versus non-adaptive seating on M.'s handwriting skills, the author observed her during eight occupational sessions with two different seating positions. The observation was completed to see how adaptive or dynamic seating might interfere with her handwriting skills, while she was writing letters of the Greek alphabet. During the non-adaptive seating portion of the study, M. was seated in a wooden chair with a backrest without having her feet on the floor or any inclination lf her seat or the table. She used a regular wooden pencil with a typical school table in front of her. Her posture was typical with a posterior tilt of the pelvis, hypotonic and flexed trunk, flexed head, internal rotated shoulders and flexed elbows. Her legs were often changed from a flexed to an extension pattern due to increased tone in the effort of writing (see Figure 1). As she tried to make her posture stable, her head came much closer to her wrist and the pencil, resulting in increased tone of her both arms especially the left one. During the adaptive seating portion of the study M. was seated in

the same wooden chair, but she had both of her feet resting on a non slip foot step, which did not impinge on circulation or limit joint range of motion at the hips, knees, or ankles. A ten-degree inclination wedge was inserted in the seat aiming for the anterior tilt of her pelvis and activation of the trunk (see Figure 1). An adjustable table with a cutout and inclination tray was used instead of the previous one to give better stability to the upper part of her body and arms as well as better visual range. Her trunk was in an upright alignment, her shoulders in a neutral position and her forearm and wrist were supported on the table. She wrote using a special pencil grip attached to the wooden pencil due to increased tone of hand and the fingers.

Results and Conclusions

It appeared that the position of the center of gravity of the upper trunk, relative to the sitting base, had a significant effect on the upper extremities function. With anterior tilt of the pelvis, support of the lower limbs and weight bearing at the forearms, active sitting resulted in active extension of the trunk that improved head control, rather than the abnormal extensor or sometimes flexor pattern. The reduction in hip flexion, tilting of the pelvis anterior and thus limitation of the extensor tendency resulted in benefits for this functional activity, i.e., the writing activity. Marked differences in postural control and the function of writing grasp procedure were found between the two sitting positions. Minor improvements were identified in the size and style of the letters. This study's results did not show any negative effects of the adaptive–dynamic sitting position on M.'s writing skills.

Children spend a large portion of their day at school with much of that time spent in the classroom (Annette & Jens, 1994; cited in Savanur, Altekar, & De, 2007). Their school workspace environments are important to their growth and performance (Savanur, Altekar & De). It is important to provide children with school furniture that matches their physical needs to prevent potential posture health problems (Savanur, Altekar & De) and maximize their educational prospects. Adaptive seating should be individualized to meet the differently needs of each child.

A general trend of data of this study suggests that the use of dynamic seating will benefit children with Cerebral Palsy and other neurodevelopmental conditions to maximize their potential for learning and participation in life. There is limited evidence from this study to suggest that an adaptive sitting position will lead to improvements in the writing performance of a child with Cerebral Palsy. Further studies should examine the link between the dynamic seating and the writing skills of children with a Mild or Moderate Spastic form of Cerebral Palsy.

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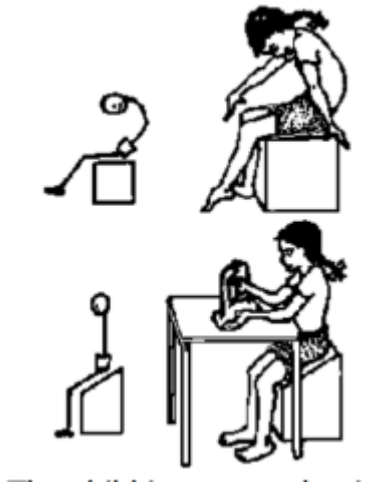
Werner, D. (1998). Nothing about us without us: Developing innovative technologies for, by, and with disabled persons. USA: HealthWrights.ß Appendix Figure 1: A child in a non-adaptive and adaptive seating position. Above: The child in a non adaptive position Below: The child in an adaptive position

Appendix Figure 1: A child in a non-adaptive and adaptive seating position



Above: The child in a non adaptive position
Below: The child in an adaptive position (Werner, 1998)