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Original Article

Abnormal sitting pressures of hemiplegic cerebral palsy children on a school chair

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Abstract. [Purpose] The purpose of this study was to investigate the differences in symmetry of sitting posture between typical developmental (TD) children and hemi-cerebral palsy (CP) children. [Subjects and Methods] A school chair mounted on a force platform was used to assess the quiet-sitting pressure distribution of 10 TD and 10 CP children. [Results] The symmetry index of the TD children was significantly closer to zero than that of the CP children irrespective of the latter group's hemiparetic side. [Conclusions] Sitting posture on school chairs of CP children was more asymmetrical than that of TD children.
Key words: Center of pressure, Children with hemi-cerebral palsy, Sitting posture

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INTRODUCTION

Despite advancements in modern medical science and the health management industry, the incidence of cerebral palsy (CP) continues to rise[1)]. The most common features of CP are decreased muscle strength and abnormal muscle tone[2)]. CP sufferers lack theability to generate enough force to maintain antigravity postural control, which result in abnormal postures[3)]. Impaired control of posture is the main component of the definition of CP[4)]. The development of movement and posture may be altered by non-progressive damage to the brain and subsequent neurological impairments (spasticity, muscle weakness, co-contractions and visual impairment)[5)]. Studies indicate that children and adults with both mild and severe forms of CP have postural impairments[6–8)]. Dysfunctional posture control interferes with the activities of daily life[6)]. The emergence of sitting postural control in early infancy changes the way infants interact with the world. From the sitting position, looking, reaching, and interacting become functional and allow exploration that supports learning and further development of motor skills. Therefore, independent sitting, defined as not needing support from a caregiver or pillow while sitting, is one of the first developmental goals for every child. Individual differences are present between children, and characteristic signs of developmental disorders during infancy are relatively unspecific. Therefore, why a specific child is not able to achieve sitting postural control is not always clear.

One method of examining postural control in adults and children is to measure the center of pressure (COP) at the base of support using a force platform during the task of remaining upright. COP has frequently been used to investigate postural control during standing by young children who are healthy or have CP[9, 10)]. The purpose of this study was to investigate the differences of the pressure distributions of the sitting postures of typical developmental (TD) children and children with CP.

SUBJECTS AND METHODS

Twelve CP childrens were recruited from an outpatient rehabilitation clinic. They were hemiparetic, had an MMSE-K score above 24[11)], could maintain an independent sitting posture without support. Diplegic children were excluded due to their diversity. Two of the CP children were subsequently excluded because they refused to participate in this experiment. Ten age-matched controls were also recruited. All parents of the enrolled participants provided their written informed consent to their children's participation prior to this experiment, in accordance with the ethical principles established in the Declaration of Helsinki. As a result of the exclusion, data from only 10 CP children were collected. This study used two school chairs mounted on a force platform to assess the quiet-sitting pressure distribution of the subjects. FSA seating assessment (Canada) was used to assess the symmetry of participants. The acquisition frequency was set at 5 Hz. The stated working range of the device is 0–200 mmHg, with a resolution of 1 mmHg. The system was also calibrated to assign absolute pressure values to the digital output from an A/D converter connected to the sensing pad.

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This was done by applying a pressure distribution as similar to actual conditions as possible.

We first measured the height of subjects. Then thus subjects sat on one of two school chairs according to their height. The chairs were those generally used in school. For research purposes, this study used two basic school chair because students spend a long time of day-to-day sitting on them. One chair had a 40 cm floor to seat height, a 35 cm seat depth, and a 32 cm seat width and is designed for 122.4–133.5 cm height of subjects. The another had a 35 cm floor to seat height, a 38 cm seat depth, and a 35 cm seat width, and is designed for 133.6–152.7 cm height of subjects. The symmetry index (SI) formula is shown below[12]. It has been used for the posture symmetry in other study[13].

$$\text{Symmetry Index} = \frac{Values(nonparetic)Values(paretic)}{Values(nonparetic)+Values(paretic)} \times 2 \times 100$$

Statistical analyses were performed using PASW 18.0. Descriptive statistics were calculated (frequency, mean, standard deviation, range). The Mann-Whitney U-tests and Wilcoxon's signed rank tests were used to analyze differences between the groups and differences in lesion side, respectively. The SI of the age matched TD group was employed as the normal criteria.

RESULTS

Table 1 shows the general characteristics of the participants. The SI of the TD group was significantly closer to zero than that of the CP group of children. The SI of left hemiparetic CP and right hemiparetic CP were respectively 4.96 (2.24) and 5.12 (0.83) with no significant difference between the hemiparetic sides.

DISCUSSION

The purpose of the present study was to investigate the differences in sitting posture of children with CP while they sat on school chairs. It is known that dynamic postural control during sitting can be reliably assessed using COP data of infants who are developing typically or infants with or at risk of CP[14].

The principal finding of this study is that CP children's sitting posture is asymmetrical, leaning to the less-paretic side. We thought that infants who are developing typically develop the ability to sit by exhibiting an optimal range of movement variability, whereas CP may present either too much or too little variability leading to a very rigid and narrow or unpredictable set of movement solutions to achieve independent sitting. The finding of this study is agreement with previous studies that have the dissimilarities of the COP patterns of infants with CP and TD have been obviously demonstrated[14]. Future studies should evaluate the compensated sitting posture of CP children.

Table 1. General characteristics of the subjects

	Cerebral palsy group (n=10)	Typical developmental group (n=10)
Age (years)	8.04±0.82	7.84±0.94
Gender (male/female)	5/5	4/6
Lesion side (right/left)	4/6	
Symmetry index (mean±SD)	5.04±1.34	2.30±2.76

The present study had some limitations. The results cannot be generalized to all CP children because the sample was limited to ten children and they were at the one stage of the developmental process. Future studies should assess the relationship between symmetry of sitting posture and functional activities.

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