Original Article

Changes in gluteal pressure and center of force during sitting in children with cerebral palsy

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Abstract. [Purpose] The purpose of this study was to measure gluteal pressure and center of force (COF) during sitting in children with cerebral palsy (CP). [Subjects and Methods] The participants were five children with CP and five typically developing controls. We measured peak gluteal pressure and COF using the TekScan system. During the measurements, all children sat on the therapeutic table for 1 minute without back and foot support. [Results] The peak gluteal pressure and COF in children with CP were significantly higher than values in controls. [Conclusion] This study suggests that it is important to distribute hip pressure evenly and transfer COF in a forward direction during rehabilitation in children with CP.

Key words: Cerebral palsy, Gluteal pressure, Sitting

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INTRODUCTION

With medical progress, the number of cerebral palsy (CP) patients is increasing globally. Generally, an upright posture during sitting decreases internal disc pressure¹⁾. An upright posture results in anterior pelvic tilt, normal lumbar lordotic curve, and a neutral and relaxed thorax¹⁾. However, CP patients lack postural stability against gravity, and abnormal posture, such as a hunched trunk and posterior pelvic tilt, are common in children with CP²⁾. Because most children with CP have postural problems, they spend more time sitting than standing in daily life³⁾. Prolonged pressure on the surface of the skin can cause obstructions in capillary blood flow, leading to ischemic damage⁴⁾. Therefore, it is important to measure gluteal pressure and center of force (COF) in children with CP. Despite the importance of gluteal pressure and COF in sitting, limited studies have explored these variables in children with CP. Therefore, we measured the peak gluteal pressure and COF during sitting in children with CP.

SUBJECTS AND METHODS

The participants in this study were five children with CP (age 9.0 ± 1.2 years, height 128.5 ± 3.9 cm, weight 27.8 ± 6.0 kg; three with diplegia, two with hemiplegia) and five age-matched typically developing controls (age 9.4 ± 0.8 years, height 138.7 ± 4.4 cm, weight 34.5 ± 7.8 kg). Ethics approval was obtained from the Inje University Ethics Committee for Human Investigations, and written informed consent was obtained from all participants (2016-05-004). Children with sensory deficits, those who had undergone surgery within the last 6 months, and those who could not sit independently for 5 minutes were excluded from the study. The TekScan system was used to assess peak gluteal pressure and COF. The TekScan software displayed temporal forces, peak gluteal pressures, and COF on a monitor. We then compared the groups with regard to peak

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gluteal pressure and COF while sitting. During measurement, the children sat on the therapeutic table for 1 minute without back and foot support. All measurements were repeated three times, and the mean value was used for analysis. Approximately 10-second rest periods were allowed between assessments. The Mann-Whitney U-test was used to determine significant differences between children with CP and controls. PASW Statistics software (ver. 20; Norusis/SPSS, Inc., Chicago, IL, USA) was used for all analyses, and the level of statistical significance was set at $\alpha=0.05$.

RESULTS

The peak gluteal pressure during sitting in children with CP (0.44 ± 0.05 kg/cm²) was significantly higher than that in typically developing children (0.31 ± 0.06 kg/cm²) ($p=0.016$). Furthermore, the COF during sitting in children with CP (12.38 ± 1.26 cm) was significantly higher than that in typically developing children (8.58 ± 0.61 cm) ($p=0.009$).

DISCUSSION

The purpose of this study was to investigate peak gluteal pressure and COF during sitting in children with CP. The results showed that values on both measures were significantly higher in children with CP compared with controls ($p<0.05$). Lee and Park reported differences in the symmetry index (SI) in children with CP compared with typically developing children. In the present study, the SI value in children with left hemiplegic CP was 4.96 (2.24), whereas that in normal controls was closer to zero⁵. van der Heide et al. explored postural control during reaching in children with CP, and found that children with CP had reduced trunk extensor muscle activity compared with typically developing children. Furthermore, children with CP showed inappropriate muscle-recruitment patterns⁶. Our study supports the results of these previous studies, suggesting that peak gluteal pressure during sitting may be higher in children with CP than in controls because uneven weight distribution due to CP results in higher gluteal pressure. Additionally, in children with CP, the COF during sitting was transferred in a posterior direction compared with typically developing children. This result may reflect decreased sitting balance in children with CP. Overall, our results suggest that it is important to distribute hip pressure evenly and transfer COF in a forward direction during rehabilitation in children with CP.

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