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論　文　名	Immediate effects of quick trunk exercises performed in a seated position on sit-to-stand movement in children with spastic cerebral palsy 座位での速い体幹運動が脳性麻痺児の立ち上がり動作に及ぼす即時効果について
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論文要旨

The sit-to-stand (STS) movement is a common skill of daily living and an important measure of physical function that requires adequate postural control to transfer the center of mass over the feet and maintain alignment of the upper and lower body segments. However, children with cerebral palsy (CP) have difficulty in performing STS movement effectively, as they often show deficits in movement and postural control. Therefore, improvement of STS performance plays a crucial role in the improvement of social participation in these children. Previous studies demonstrated beneficial effects of some intervention in STS of children with CP. However, the main focus of these interventions was on lower limb impairment with less consideration of the key role of trunk control during STS movement and its deficit in children with CP. From these points of view, we are interested in understanding whether quick trunk movements could improve trunk control in children with CP and therefore allow them to perform STS more efficiently. Thus, this research study aimed to assess the immediate effects of a quick-seated trunk movement exercise (QSTE) on STS movement in children with CP.

In research I, the study participants included five children with spastic CP, aged 6–17

years. All participants received five sessions of natural STE (NSTE) at a self-selected speed as a control intervention. Following a 50-min rest period, five sessions of the QSTE were conducted as an experimental intervention for each child. Assessments were performed before and after each intervention in a single day. To assess STS movements, a motion analysis system with four cameras that were synchronized with a pressure-sensitive trigger device was used. The sagittal and angular movements of the trunk, hip, knee, and ankle were calculated. Then, the total STS task duration and the maximum trunk forward tilt and ankle dorsiflexion angle were calculated.

The results of research I showed a significant difference in the total duration of the STS movement before and after NSTE (2.40 ± 0.67 s vs. 2.24 ± 0.44 s) and QSTE (2.41 ± 0.54 s vs. 2.06 ± 0.45 s). However, there was no significant difference in the kinematic parameters after both interventions.

Despite the same STS performance before natural and quick STE, possibility of learning effects due to the single day measurement may limit the generalization of the results in research I.

Thus, to decline this limitation, multiple day measurement was chosen in research II. A total of seven children with spastic diplegia CP, aged 4–13 years, participated in this study. All subjects participated in both experimental and control intervention. First, participants were assessed before the experimental intervention (pre-test). Then, after 3–5 days of washout period, they were reassessed (post-test) immediately after receiving five sessions of QSTE for experimental intervention. Second, after 2-4 weeks of interval, all participants were assessed before the control intervention (pre-test). Following 3–5 days of washout period, they were reassessed immediately after control intervention (post-test). The participants sat for 10 minutes on a stool for the control intervention. A conventional video recording camera was used to record STS movements. The sagittal and angular movements of the trunk, hip, knee, and ankle were calculated for each lower limbs using Image-J. Then, the total STS task duration was calculated.

The results of research II showed that the start position and STS duration of pre-test data were not significantly different for experimental and control intervention. A significant difference was observed in the total duration of the STS movement before and after QSTE (2.67 ± 0.34 s vs. 1.69 ± 0.11 s). However, no significant change was found between the total duration of the STS movement before and after control intervention (2.49 ± 0.25 s vs. 2.41 ± 0.18 s).

The total duration of the STS movement significantly decreased after QSTE in both researches. Although QSTE did not change the abnormal kinematic pattern of the STS movement, QSTE may improve trunk control, which in turn would help children with CP to

perform STS movement faster. These improvements would facilitate their social participation and lead to better performance during daily activities.

Keys Words: Fast trunk exercise, Sit-to-stand, Cerebral palsy

審査結果の要旨

本研究は、脳性麻痺児（CP 児）の日常生活に不可欠な立ち上がり動作に対して、座位で体幹を素早く動かすエクササイズ（quick-seated trunk movement exercise: QSTE）を実施し、立ち上がり動作に対してどのような即時効果が認められるかについて検証を行った研究である。

Research 1 では、5 名の CP 児に対して、 QSTE と通常速度で座位での体幹を動かすエクササイズを実施し、間接角度などの運動学的指標に変化は認められないものの、立ち上がり動作に要する時間が短縮することを明らかにした。しかし、この研究では、対象として片麻痺と両麻痺が混在していることや、1 日で実施したため学習効果や持ち越し効果を考慮出来ていないこと、通常速度の規定が不十分であることなど、幾つかの研究限界があった。

そこで、Research 2 では、これらの研究限界に対して、対象者を両麻痺に限定すること、測定の間隔を十分に空けること、さらにコントロールとして安静座位を採用することで対応し、QSTE の効果を検証した。その結果、QSTE によって、立ち上がりに要する時間が有意に短縮することが示された。

CP 児は個別性が高いため、介入方法の効果を数値で表し、検証することは容易ではない。本研究では、QSTE によって立ち上がり動作に要する時間が有意に短縮するという新しい知見を明確に示しており、その点において博士学位論文としての水準を満たしていると判定できる。さらに、Research 1 は日本で、Research 2 はイランで実施しており、人種や環境の異なる両国において、同様の結果が得られたことから、普遍的な介入方法であることを示した点においてもその意義は大きいと考えられる。