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Case Study

Effects of therapeutic climbing activities wearing a weighted vest on a child with attention deficit hyperactivity disorder: a case study

Hye-Sun Lee, MSc, OT[1)], Chiang-Soon Song, PhD, OT[2)*]

[1)] *Department of Occupational Therapy, Kwangju-Women's University, Republic of Korea*
[2)] *Department of Occupational Therapy, College of Health Science, Chosun University: 309 Pilmun-daero, Dong-gu, Gwangju 501759, Republic of Korea*

Abstract. [Purpose] The purpose of this study was to evaluate the effect of therapeutic climbing activities on the brain waves and attention of a child with attention deficit hyperactivity disorder. [Subject and Methods] The subject of this case study was a 7 year 6-month old child diagnosed with attention deficit hyperactivity disorder. This study was based on evidence gathered at 3 distinct stages: a pre-intervention period, 10 intervention periods (2 weeks), and one post-intervention period. The intervention involved therapeutic climbing activities wearing a weighted vest over the course of 4 weeks. The clinical outcome measures were electroencephalography and the Star Cancellation Test. [Results] The mean activation of alpha waves was improved by the therapeutic intervention. During the intervention, the mean activation of alpha waves was the highest at the F3 cortical locus and the lowest at the T4 cortical locus. The average Star Cancellation Test scores were 43 at pre-intervention, 50 during the therapeutic intervention, and 52 at post-intervention. The performance time of the Star Cancellation Test was 240.1 seconds at pre-intervention, 90.2 seconds during the therapeutic intervention, and 60.0 seconds at post-intervention. [Conclusion] The results of this study suggest that therapeutic climbing activities performed wearing a weighted vest had positive effects on the brain waves and the attention span of a child with attention deficit hyperactivity disorder.
Key words: Attention, Brain wave, Sensory

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INTRODUCTION

Attention deficit hyperactivity disorder (ADHD) is a behavioural disorder frequently diagnosed in pre-school and school-aged children. It is the most prevalent chronic neurobehavioral disorder in children and is characterized by inattention, hyperactivity, and impulsiveness. Children with ADHD are characterized by inattention, their persistence in asking meaningless questions, struggling to follow instructions, blurting out inappropriate words or comments, unrestrained emotions, and impulsive actions. Therefore, a child with ADHD will engage in dysfunctional and maladaptive behaviours at home as well as in social, educational, and occupational settings[1–3)].

Adults with ADHD generally rely on pharmacological interventions for treatment in clinical settings, but for children with ADHD, they and their parents prefer a non-phamacological intervention to ameliorate the symptoms and allow the children to engage in functional activities as well as achieve a good quality of life. Previous studies have reported that sensory integration activities improve the attention and arousal of children, ultimately leading to the emotional stability of children with ADHD[4)]. Deep pressure is a sensory integration technique that can help alleviate the symptoms of neurobehavioural disorders[5)]. A weighted body jacket is a cost-effective deep pressure technique that can be administered to ADHD children in a clinical setting. Previous studies have suggested that these jackets regulate arousal, increasing the attention span of children with ADHD[6, 7)]. Recently, several studies have suggested that there is relationship between movement and cognitive function associated with ADHD and its associated cognitive control impairments. These studies have suggested that children with ADHD utilize movement to self-regulate lateness and physical activity, improving the cognitive performance of children with ADHD[8)].

This study investigated the usefulness of intensive physical activity combined with deep pressure for the improvement of cognitive performance. In this study, the patient was instructed to perform therapeutic climbing as an intensive physical activity, and a weighted vest was used to administer deep pressure. The purpose of this study was to investigate the effect of therapeutic climbing wearing the weighted vest on both the brain waves and attention span of a child with ADHD.

*Corresponding author. Chiang-Soon Song (E-mail: grsong@chosun.ac.kr)

Table 1. Alpha wave activation in the brain areas of the body with ADHD

Electrodes	Pre intervention	Therapeutic intervention						Post intervention
		First	Second	Third	Fourth	Fifth	Mean	
FP1 (%)	15.9	27.3	31.7	21.7	25.7	27.0	26.7	24.8
FP2 (%)	15.5	26.0	28.8	21.7	24.7	26.4	25.5	25.0
F3 (%)	23.9	43.3	44.5	36.1	38.9	41.0	40.8	37.0
F4 (%)	27.7	30.4	31.6	19.3	32.0	34.0	29.4	21.0
T3 (%)	17.5	37.0	35.0	27.4	36.1	32.2	33.6	31.0
T4 (%)	27.3	26.2	24.0	18.9	28.1	25.3	24.5	22.4
P3 (%)	32.9	44.9	39.0	32.4	31.0	35.0	36.5	31.0
P4 (%)	37.6	45.0	37.2	33.3	37.0	36.0	37.7	39.0
Mean (%)	24.8	35.0	34.0	26.4	31.7	32.1	31.8	28.9

FP1: Frontopolar 1; FP2: Frontopolar 2; F3: Frontal 3; F4: Frontal 4; T7: Temporal 7; T8: Temporal 8; P3: Parietal 3; P4: Parietal 4

SUBJECT AND METHODS

The participant of this study was a boy who was diagnosed with ADHD by a paediatrician in 2009. He was in the third grade of elementary school, 7 years and 3 months old, and his IQ was 115. He was born by Caesarean section at 39 months and had a birth weight of 3.5 kg. At the age of 4, he went to school and studied the abacus three times a week after school. He had difficulty in engaging in age appropriate behaviours and conducting himself in a group, and demonstrated inappropriate behaviours such as hitting peers or failing to follow instructions. He was not diagnosed with any diseases or disability, had no visuoperceptual problems, and had not taken any medication for 6 months prior to this clinical intervention. Before the intervention, he was examined by three general clinical measures, including the ADHD Rating Scale, Short Sensory Profile, and Korean Developmental Test of Visual Perception-2, and scored 28, 143, and 109 points, respectively. This study was carried out in accordance with the International Ethical Guidelines and the Declaration of Helsinki and was approved by the Gwangju University Institutional Review Board. Both the boy and his parents voluntarily signed the consent forms.

The present study was a case study designed to examine the effects of a therapeutic climbing program on a boy with ADHD, using electroencephalography (EEG) and the Star Cancellation Test (SCT) to measure his response to this therapeutic climbing activity. This study was divided into four weeklong periods: the pre-intervention phase, 1 week; the therapeutic climbing activity intervention period, 2 weeks; and the post-intervention phase, 1 week. This study measured the alpha waves of the patient using an EEG once in the pre-intervention period, 5 times in the intervention period, and once in the post-intervention period. The patients' attention abilities were examined using the SCT (carried out at the same time as the EEG). In the pre-intervention period, the boy engaged in a preliminary climbing activity three times in the week while wearing a weighted vest. The therapeutic climbing activities wearing the weighted vest consisted of three phases as follows: stretching for a warm-up (5 min), climbing activities (50 min), and finally stretching for a cool-down (5 min).

EEG was performed using QEEG-8 (LXE3208, Daejeon, Republic of Korea) with a 256 Hz sampling wave and 8 recording electrodes on the frontal, temporal, and parietal lobes (F1, F2, F3, F4, T7, T8, P3, and P4). A clinical psychologist performed EEG measurements and analysis at the brain center of G city. The SCT developed by Wilson et al. evaluates the presence of visuospatial neglect, and consists of one paper containing 52 large stars, 10 short words, and 13 letters, randomly positioned, with 56 small stars interspersed among them. At the beginning of the SCT, the administrator instructed the subject to cross out (with a black pen) all the small stars on the paper, and demonstrated the procedure by crossing out the two central stars. The maximum correct score is 54. The number of missed targets and performance time recorded[9].

In this study, EEG was used to detect alpha wave activation to evaluate the effects of the therapeutic climbing activities in a child with ADHD. The formula used to calculate the alpha wave activation was as follows: active period of alpha wave / (active period of theta wave + alpha wave + beta wave + gamma wave + delta wave) × 100.

RESULTS

The mean of alpha wave activation was 24.81% at pre-intervention, 31.82% during the therapeutic intervention, and 28.92% at post-intervention (Table 1). During the therapeutic intervention, the mean alpha wave activation was the highest at the F3 cortical region (40.76%) and the lowest in the T4 cortical region (24.51%). The average SCT scores were 43, 50, and 52 points at pre-intervention, during the therapeutic intervention, and at post-intervention, respectively. The performance time of SCT was 240.1 seconds at pre-intervention, 90.2 seconds during the therapeutic intervention, and 60.0 seconds at post-intervention (Table 2).

DISCUSSION

The current study was designed to evaluate the combined effects of therapeutic climbing activities while wearing a weighted vest administration on the brain waves and attention span of a boy with ADHD. The results of this study

Table 2. Scores of the Star Cancellation Test at pre-intervention, during the therapeutic intervention, and at post-intervention

Variable	Pre intervention	Therapeutic intervention						Post intervention
		First	Second	Third	Fourth	Fifth	Mean	
SCT number	43	46	50	50	52	52	50	52
SCT period (second)	240.1	147.2	119.0	95.2	60.1	60.1	90.2	60

demonstrate that the therapeutic climbing activities while wearing a weighted vest improved the alpha wave activation and attention ability of the patient. Although EEG technology is not routinely used to measure the clinical efficacy of ADHD treatments, in this study, EEG was used to evaluate neuropsychiatric traits such as inattention, hyperactivity, and impulsive activation. Previous studies have also proposed using EEG to investigate clinical changes and therapeutic prognosis. For example, Rodrak and Wongsawat reported that children with ADHD have a deficit in delta, theta, and alpha wave activities[10, 11]. This study found that a boy with ADHD showed improved alpha wave activation following the therapeutic climbing activity wearing a weighted vest. Jiang et al. suggested that children with ADHD might have obvious left spatial neglect, and there might be a common neurophysiologic mechanism between the left spatial bias and ADHD[12]. The present study found there were improvements in the attention abilities and visuospatial function, as measured by SCT, of a child with ADHD[12]. These findings may be helpful for determining the feasibility of providing therapeutic climbing activities while wearing a weighted vest in the treatment of children with ADHD. Furthermore, the authors concluded that it is feasible to use EEG technology to measure the therapeutic effects of ADHD treatments.

The results of this study cannot be generalized to all children with ADHD because this study used a case design with only one child with ADHD. Our results suggest the need for further investigation of the effects of therapeutic climbing activities while wearing a weighted vest on children with ADHD. This study also suggests that group programs that include therapeutic climbing activities while wearing weighted vest may be helpful in the treatment of children with ADHD. These group programs may also have the additional benefit of addressing the social difficulties of children with ADHD.

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