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# Intervention methods for postural abnormalities in patients with Parkinson's disease

## - Focusing on proprioception and tactile stimulation -

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## Chapter 1 Introduction

In recent years, the number of patients with Parkinson's disease has been increasing as the population ages. Parkinson's disease symptoms include motor and non-motor indicators. Medication is the first choice for treatment, but as there are symptoms for which it is not effective (postural reflex disorders, postural maintenance disorders, swallowing/anarthria, autonomic nervous disorders, mental/psychological disorders, etc.), it is recommended to use medication in combination with rehabilitation. In particular, the abnormal posture of patients with Parkinson's disease is caused by abnormal muscle tone (rigidity) and impaired integration of sensory information, which greatly affects their mental and psychological aspects.

## Chapter 2 Purpose and structure of this research

First, as changes in posture are thought to lead to changes in psychological aspects and autonomic nervous activity, we need to conduct basic research on posture and psychological/autonomic nervous activity in healthy subjects and Parkinson's disease patients before considering intervention methods (Studies 1, 2, and 3). Next, Studies 4 and 5 aim to examine intervention methods to improve postural abnormalities in Parkinson's disease patients. Here, we perform interventions for rigidity and sensory integration disorders and verify the effects on posture and psychological/autonomic nerve activity. We believe that this study may help provide evidence for physical therapy intervention for abnormal posture in Parkinson's disease patients.

## Chapter 3 Basic research on posture related to autonomic nerves, mood, and emotions

First, in Study 1, we investigated head and neck flexion angle (CV angle), spinal curvature index (OWD), spinal column angle, mood-emotional scale (POMS), and autonomic nerve activity while sitting and standing at rest in healthy adults. The results revealed a correlation between OWD and negative emotions. Furthermore, CV angle showed a correlation with parasympathetic nerves in sitting and standing positions. Additionally, a negative correlation was found between posture, physical condition, and OWD.

Next, in Study 2, similar to Study 1, we performed a jaw-pulling task on healthy adults and compared their posture before and after the task and their autonomic nerve activity at rest. The task was performed 10 times for 5 seconds in a sitting position.

We found that the CV angle was improved and parasympathetic nerve activity (HFnuRRI) significantly increased but no significant difference was observed in sympathetic nerve activity (LF/HFnuRRI). The results of Experiments 1 and 2 showed that changes in CV angle were correlated with resting parasympathetic activity and OWD was correlated with negative emotions. A chin-tuck task has been shown to improve head and neck flexion angles, suggesting that it may also affect the autonomic nervous system.

## Chapter 4: Relationship between posture, autonomic nerves, and mood in Parkinson's disease patients (Study 3)

This chapter investigated the relationship between posture, the autonomic nervous system, and mood in patients with Parkinson's disease. The results showed that fear of falling was correlated with H&Y and OWD severity. CV angle was correlated with autonomic nervous activity, negative

emotions, and trapezius muscle brightness. It has been suggested that the intervention of forward bending of the head and neck may affect the autonomic nervous system, mood, and emotions by changing posture.

**Chapter 5 Immediate effects of the jaw pulling task in Parkinson's disease patients (Study 4)**

Immediate effects were assessed by performing a chin-tuck task in Parkinson's disease patients and measuring CV angle, OWD, autonomic nerve activity, muscle thickness, and muscle brightness (levator scapulae and trapezius muscles). Although there was a significant improvement in CV angle before and after the task, no significant differences were observed in OWD, resting sympathetic, and parasympathetic. Furthermore, significant differences were observed in the muscle thickness and muscle brightness of the trapezius muscle. These results suggest that the jaw-tuck task activated deep neck muscles, decreased the forward flexion angle of the cervical spine, and decreased the thickness of the trapezius muscle.

**Chapter 6: Immediate effects of tactile stimulation intervention on the neck in Parkinson's disease patients and autonomic changes during the intervention (Study 5)**

We conducted an intervention using tactile stimulation of the sternocleidomastoid muscle in patients with Parkinson's disease. Immediate effects were examined from CV angle/OWD, autonomic nerve activity, muscle thickness, muscle brightness (levator scapulae, trapezius, sternocleidomastoid, longus cervix), and subjective symptoms. Before the intervention, a 5-minute control condition was set, which was equivalent to the intervention time. The intervention using tactile stimulation was performed for 5 minutes by applying a pressure of 400 to 800 g at a speed of 5 cm per second to the sternocleidomastoid muscle. As a result, in the control condition, no significant differences were observed in OWD, CV angle, muscle thickness, muscle brightness, autonomic nerve activity, and VAS. On the other hand, after the intervention, OWD improved, sternocleidomastoid muscle thickness decreased, heart rate decreased, and VAS showed significant improvement in posture and comfort.

**Chapter 7 Comprehensive consideration**

This study focused on patients with Parkinson's disease and examined basic research and intervention methods on the effects of changes in posture on physical function, mental health, and the autonomic nervous system. The results showed that the functions related to the forward bending angle differed between healthy subjects and Parkinson's disease patients. Furthermore, regarding the intervention method, the angle of the neck improved with the chin-pulling task, and the intervention with tactile stimulation improved OWD and autonomic nerves. In other words, when intervening in physical function, it is necessary to pursue a comprehensive approach that considers other symptoms and disorders, and we believe that this will help future treatments and interventions for Parkinson's disease patients.

Limitations of this study include the small number of subjects with Parkinson's disease, the need to consider comparisons with elderly people of the same age, and the need to proactively consider the sustainability of effects.