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Original Article

# Effect of intramuscular lidocaine injection with physical therapy on camptocormia in patients with Parkinson's disease who had previously had deep brain stimulation

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**Abstract.** [Purpose] We aimed to evaluate the effects of an intervention consisting of intramuscular lidocaine injection in combination with physical therapy on the standing posture, balance ability, and walking ability in patients with Parkinson's disease who had camptocormia after deep brain stimulation. [Participants and Methods] The participants were nine patients with Parkinson's disease who had previously undergone deep brain stimulation. The intervention comprised a lidocaine injection into the abdominal external oblique muscles for five days in combination with physical therapy, including body weight-supported treadmill training for two weeks. Before and after the intervention, the total and upper camptocormia angles were used to assess the standing posture; the Berg balance scale was used to assess the balancing ability; and maximum walking speed and stride length were used to assess the walking ability. [Results] The total and upper camptocormia angles, and Berg balance scale improved significantly more after the intervention than before. Before and after the intervention, there was no significant difference in maximum walking speed, but the stride length was significantly greater after the intervention than before. [Conclusion] The intervention was effective in alleviating camptocormia and improving the balance and walking abilities of patients with Parkinson's disease with camptocormia after deep brain stimulation.
**Key words:** Parkinson's disease, Intramuscular lidocaine injection, Physical therapy

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## INTRODUCTION

The motor symptoms of Parkinson's disease (PD) include appendicular symptoms such as tremors, rigidity, and bradykinesia as well as axial symptoms such as abnormal posture and the loss of postural reflexes[1)]. PD is usually treated medically. However, because of the slow progression of PD, a surgical option called deep brain stimulation (DBS) may be recommended when the effect of the medication is inadequate[2)]. DBS is reported to be effective in alleviating motor symptoms[3)] and abnormal posture[4)], but the effect may not be long-lasting[5)].

Typical postural abnormalities in PD patients include camptocormia (CC), dropped head syndrome, and Pisa syndrome[6)]. CC is an abnormal posture caused by involuntary flexion of the thoracolumbar spine during standing and walking, which abates in a recumbent position[7)]. CC is reported to affect balance and walking abilities[8, 9)] and can lead to impairment of activities of daily living as well as falls[9)]. Thus physical therapy is indicated for patients with CC.

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Dystonia affecting the abdominal external oblique muscles is one of the various etiologies of CC, and lidocaine injection into this muscle in combination with rehabilitation is reported to alleviate CC[10]. However, no studies to date have investigated an intervention consisting of intramuscular lidocaine injection in combination with physical therapy for CC in PD patients who had previously undergone DBS or the effect of such an intervention on balance and walking abilities.

Therefore, in this study, we conducted a pre- and post-comparative study of the effects of intramuscular lidocaine injection in combination with physical therapy for PD patients who had CC after DBS, and examined the effects on standing posture, balance ability, and walking ability. We hypothesized that a combined intervention of intramuscular lidocaine injection and physical therapy would be effective for PD patients who had CC after DBS.

## PARTICIPANTS AND METHODS

A total of 55 PD patients who had previously undergone DBS in the past were included in the study. Of these, 11 patients who met the criteria for CC as proposed by Margraf et al.[11] (i.e., on a sagittal image the angle between the line from the L5 spinous process to the C7 spinous process and the line from the L5 spinous process to the lateral malleolus while standing was ≥30°) and excluded those who met the following exclusion criteria were included in the analysis. Exclusion criteria are those who have difficulty walking and those with an orthopedic disorders. Oral medications were not changed in those 11 patients. In accordance with the Declaration of Helsinki, we explained the purpose of the study, that no disadvantages would be incurred in the event of non-consent, and that no disadvantages would be incurred in the event of withdrawal from participation during the course of the study, and obtained written consent from all participants. This study was approved by the Ethics Committee of Kanazawa Neurosurgical Hospital (approval number R1-05).

Intramuscular lidocaine injection was given for five days. A doctor with over 40 years of experience identified the abdominal external oblique muscle and injected lidocaine (xylocaine injection 1%, 10 mL) under ultrasound guidance.

Physical therapy was performed immediately after the intramuscular lidocaine injection. Five sessions per week were provided for two weeks, and each session comprised 20 min of limb and trunk stretches followed by four five-min sets of body weight-supported treadmill training (BWSTT). The amount of support was set at 20% of body weight, following Ganesan et al.[12] Walking speed was set to a speed that allowed the patient to keep their trunk straight at the central position. Patients were asked to maintain this posture while taking strides as large as possible.

Assessments were performed when symptoms were well controlled within 30–120 min after taking oral medication for PD. The following patient characteristics were collected: age, gender, duration of PD, duration since DBS, severity of PD according to the Hoehn & Yahr scale, score on the Movement Disorder Society-Sponsored Revision of the-Unified Parkinson's Disease Rating Scale (MDS-UPDRS) Part III, and the daily equivalent dose of levodopa (an agent for PD).

Standing posture was assessed by measuring the total CC angle (TCCangle) and the upper CC angle (UCCangle). Following Margraf et al.[11] TCCangle was defined as the angle on a sagittal image between the line from the L5 spinous process to the C7 spinous process and the line from the L5 spinous process to the lateral malleolus while standing. UCCangle was defined as the angle between the line from the C7 spinous process to the inflection point and the line from the L5 spinous process to the inflection point. The inflection point was defined as the point where the line parallel to the line from the C7 spinous process to the L5 spinous process crosses the contour of the trunk. To determine TCCangles and UCCangles, reflective markers were placed on the C7 spinous process, L5 spinous process, and the lateral malleolus and still images were captured using a camera on a tablet (Fig. 1). Patients were asked to stretch as much as they could while the images were captured. The angles were analyzed using ImageJ ver.1.53 (National Institutes of Health, Bethesda, MD, USA).

Balance ability was assessed using the Berg balance scale (BBS), which contains 14 items (e.g., sitting to standing, standing unsupported, placing alternate foot on a stool, standing with one foot in front, and standing on one foot), each of which is scored from 0 to 4 points, for a maximum total score of 56[13]. Higher scores indicate better balance ability.

Walking ability was assessed in terms of maximum walking speed (MWS) and stride length. Patients were asked to walk as fast as possible on a 14-m straight pathway, which included an initial two-m segment and a final two-m segments that were excluded from the assessment of walking time. The time required to walk the middle 10-m segment was measured using a stopwatch, and the number of steps was counted. The measurement was performed only once. MWS was calculated by dividing the length (10 m) by the time measured, while stride length was calculated by taking the square of the length and dividing that value by the number of steps.

The Wilcoxon signed rank test was used to analyze the effect of the intervention on the standing posture, balance ability, and walking ability between before and after the intervention. The analysis was performed using SPSS for Windows ver. 22 (IBM Corp., Armonk, NY, USA). A p-value of <5% was considered to indicate statistical significance.

## RESULTS

One patient became unwell during hospitalization and another withdrew from the intervention, and thus only the results of the remaining nine patients (six females and three males, age: 67.4 ± 2.4 years, mean ± SD, Duration of PD: 17.2 ± 7.0 years, Duration since DBS: 6.3 ± 5.3 years, The daily equivalent dose of levodopa: 394.4 ± 59.8 mg, Hoehn & Yahr stage: 3.4 ± 0.5 points, MDS-UPDRS Part III: 27.8 ± 8.6 points) were analyzed. The results of the assessments conducted before and after the intervention are shown in Table 1. TCCangle was significantly smaller after the intervention (50.7 ± 20.4°) than before (65.2 ± 23.7°, p<0.01). UCCangle was also significantly smaller after the intervention (33.9 ± 8.9°) than before (41.2 ± 8.9°, p<0.01). The BBS scores was significantly higher after the intervention (43.2 ± 10.3 points) than before (36.6 ± 12.5 points, p<0.01). There was no significant difference in MWS between before (0.88 ± 0.36 m/s) and after (0.95 ± 0.39 m/s) the intervention. Stride length was significantly longer after the intervention (0.98 ± 0.24 m) than before (0.84 ± 0.20 m, p<0.05).

## DISCUSSION

In this study, we provided an intervention consisting of intramuscular lidocaine injection in combination with physical therapy for PD patients with CC who had previously undergone DBS and examined the effect of the intervention on their standing posture, balance ability, and walking ability. The intervention was effective in improving TCCangle, UCCangle, BBS score, and stride length but not MWS.

Medication was not changed in any of the participants, and thus the changes in measurements observed in this study were likely the result of the intervention. Dystonia affecting the abdominal external oblique muscles is an etiology of CC[10], and it has been reported that lidocaine reduces dystonic movements without weakening the target muscles[14]. Indeed, it has been previously reported that an intervention consisting of lidocaine injection to the abdominal external oblique muscles in combination with rehabilitation alleviated CC[15]. The present study also examined lidocaine injection to the abdominal external oblique muscle but this was combined with subsequent physical therapy. There are no established methods of physical therapy after lidocaine injection to the abdominal external oblique muscle. In this study, we opted to use stretching and BWSTT because in BWSTT, a certain percentage of body weight is supported by lifting the trunk upward using a harness, which enables the patient to keep the trunk straight at the central position during walking practice. We believe that CC was alleviated because the injection of lidocaine into the abdominal external oblique muscles reduced dystonia and patients were able to learn how to keep their trunk straight while facing forward through repeated training using BWSTT.

BWSTT is reported to be effective in improving standing stability in PD patients[16]. Impairment of balance ability was greater in PD patients with CC than in those without CC[9], suggesting that BWSTT may improve CC and balance ability.

Compared with healthy elderly individuals, PD patients with CC showed more pronounced hip flexion and greater reduction in stride length while walking[8]. During BWSTT, the trunk is lifted upward by a harness, making facilitates swinging the leg[17]. Thus, the increases in stride length observed in the present study were likely due to alleviation of CC and the use of BWSTT.

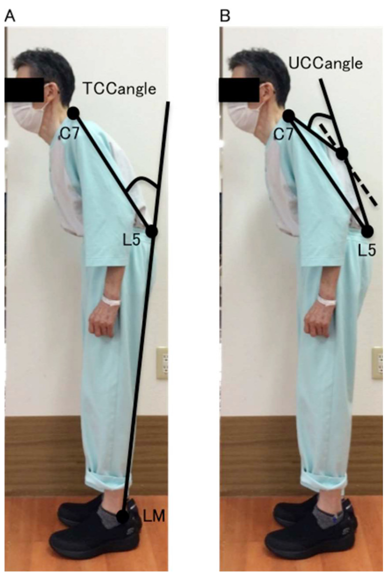


**Fig. 1.** How to measure standing posture.
A: total camptocormia angle (TCCangle), B: upper camptocormia angle (UCCangle).
TCCangle was defined as the angle on a sagittal image between the line from the L5 spinous process to the C7 spinous process and the line from the L5 spinous process to the lateral malleolus while standing. UCCangle was defined as the angle between the line from the C7 spinous process to the inflection point and the line from the L5 spinous process to the inflection point.

**Table 1.** Outcome measures of before intervention and after intervention

| Variables | Before | After |
|---|---|---|
| UCCangle (degrees) | 41.2 ± 8.9 | 33.9 ± 8.9* |
| TCCangle (degrees) | 65.2 ± 23.7 | 50.7 ± 20.4* |
| BBS (scores) | 36.6 ± 12.5 | 43.2 ± 10.3* |
| MWS (m/s) | 0.88 ± 0.36 | 0.95 ± 0.39 |
| Stride length (m) | 0.84 ± 0.20 | 0.98 ± 0.24** |

UCCangles: Upper Camptocormia angles; TCCangles: Total Camptocormia angles; BBS: Berg Balance Scale; MWS: Maximum Walking Speed. Mean ± SD.
*Significant difference the before intervention, p<0.01.
**Significant difference the before intervention, p<0.05.

We provided an intervention consisting of intramuscular lidocaine injection in combination with physical therapy for CC in PD patients who had previously undergone DBS. The intervention alleviated CC and improved the balance and walking abilities in those patients. This intervention need to be further explored as a good treatment for PD patients who have previously undergone DBS, as it may be effective even a long after DBS.

There are some limitations to this study. First, it is not clear whether the observed effects are attributable to the intramuscular lidocaine injection alone, the physical therapy alone, or the combination of both. Therefore, further study with a control group is needed. Second, although this study confirmed the short-term effects after the intervention, the long-term effects are not known and thus need to be investigated in the future.

*Conflict of interest*

There are no conflicts of interest related to this study to disclose.

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