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Short communication

# Identification of a new target muscle for treatment in patients with Parkinson's disease who have lateral trunk flexion?

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ABSTRACT

Parkinson's disease (PD) can present with lateral trunk flexion (LTF). Abnormal posture associated with PD has been treated, but the effectiveness of these treatments is limited, resulting in unsatisfactory outcomes. Unilateral hypertrophy and unilateral hyperactivity may be useful for deciding targets for injection of botulinum toxin or physical rehabilitation. However, such findings may be limited such as the obliquus abdominis muscle or thoracic paraspinal muscles, and several other muscles may have a causative role in LTF. We investigated 8 patients whether other muscles show unilateral hypertrophy by analyzing computed tomographic scans. Cobb's angle was 11° to 34°. The area of the paravertebral muscles was large contralateral to the bending side and this trend intensified from L4 to Th10. The lumbar quadrate muscle and psoas major muscle showed unilateral enlargement. These larger muscles were prominent contralateral to the bending side in five patients and ipsilateral to the bending side in two patients. This unilateral muscle change was mildly seen in the internal and external abdominal oblique muscles. The lumbar quadrate muscle or psoas major muscle showed two hypertrophic patterns, and these muscles might be new therapeutic targets for treatments such as botulinum toxin.



## 1. Introduction

Parkinson's disease (PD) can present with lateral trunk flexion (LTF). The resulting abnormal posture often affects motor function in PD, potentially compromising the quality of life. When abnormal posture develops, it often becomes irreversible. Abnormal posture associated with PD has been treated by modifying anti-parkinsonian medications, botulinum toxin, or surgical intervention, but the effectiveness of these treatments is limited, resulting in unsatisfactory outcomes. The pathophysiological underpinnings of LTF in PD remain to be fully understood. A recent study reported two different patterns of unilateral hypertrophy and unilateral hyperactivity on electromyography (EMG) in PD patients with LTF: either ipsilateral or contralateral to the side of LTF [1]. These findings may be useful for deciding targets for injection of botulinum toxin or physical rehabilitation. However, such findings may be limited to muscles such as the obliquus abdominis muscle or thoracic paraspinal muscles, and several other muscles may have a causative role in LTF. We therefore investigated whether other muscles show unilateral hypertrophy by analyzing computed tomographic (CT) scans and found that intra-abdominal muscles showed unilateral hypertrophy and might thus be a potential target for treatment.

## 2. Materials and methods

We studied eight PD patients with LTF who fulfilled the UK Parkinson's Disease Society Brain Bank criteria [2]. The degree of trunk bending was evaluated by using Cobb's angle. All patients underwent axial plane CT from levels L4 to Th6 while they were in supine position. Region-of-interest analysis of the areas of the right and left paravertebral muscles was preformed from the L4 to Th6 vertebral levels. Two reviewers visually assessed other muscles at the L4 vertebral level on CT scans to determine whether paired muscles showed unilateral differences in muscle area. Subsequently, the area of these unilateral paired muscles was calculated by region-of-interest analysis at the superior margin of the L4 vertebral level.

## 3. Results

### 3.1. Clinical characteristics of LTF

The interval between CT examination and the onset of LTF ranged from 2 months to 3 years (Table 1). Cobb's angle was 11° to 34° (median, 16.5°). Six patients had palpable muscle contractions on the back contralateral to the bending side. Levodopa was initiated in one of these patients, and the dose of pramipexole was increased in two other patients within 6 months before the onset of LTF. LTF in four patients was mildly improved by the withdrawal of pramipexole, or increasing the dosage of rotigotine or levodopa, but the severity of LTF in two patients remained unchanged after modifying the medication,

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**Table 1**
Clinical characteristics of eight patients who had lateral trunk flexion.

| | Patient 1 | Patient 2 | Patient 3 | Patient 4 | Patient 5 | Patient 6 | Patient 7 | Patient 8 |
|---|---|---|---|---|---|---|---|---|
| *Clinical features*[a] | | | | | | | | |
| Age/sex | 72/F | 68/M | 77/F | 62/F | 68/F | 76/F | 68/F | 78/M |
| Disease duration (years) | 6 | 8.2 | 6.4 | 18 | 10 m | 5.5 | 42 m | 12 m |
| Hoehn–Yahr stage | 4 | 4 | 3 | 3 | 1 | 2 | 4 | 2 |
| UPDRS part 3 | 22 | 32 | 21[c] | 9 | 12 | 17 | 32 | 17 |
| Clinical dominant | Right | Left | Left | Right | Left | Right | Left | Left |
| Wearing-off | + | + | + | − | − | − | + | − |
| Hallucinations | + | + | − | − | − | + | − | − |
| History of falls | − | + | + | + | − | + | + | − |
| Nature of the abnormal posture | LTF (right) | LTF (right) | LTF (right) | LTF (right) | LTF (left) | LTF (right) | LTF (right) | LTF (left) |
| Duration[b] (months) | 7 | 3 years | 22 | 12 | 2 | 2 years | 17 | 5 |
| Angle using Cobb method (degree) | 25 | 34 | 14 | 24.5 | 14 | 11 | 15 | 19 |
| Palpable contractions on the back contralateral to bending side | +Hypertrophy | +Hypertrophy | −Hypotrophy | +Hypertrophy | +Hypertrophy | +Hypertrophy | −Hypotrophy | +Hypertrophy |
| Low back pain | + | + | + | + | + | + | + | − |
| Lumbar quadrate muscles ipsilateral to bending side | Hypotrophy | Hypotrophy | Hypertrophy | Hypertrophy | Hypotrophy | Hypotrophy | Hypertrophy | Hypotrophy |
| Psoas major muscle ipsilateral to bending side | Hypotrophy | Hypotrophy | Hypertrophy | Hypertrophy | Hypotrophy | Hypotrophy | Hypotrophy | Hypotrophy |
| Serum creatinine kinase | 206 | 179 | 136 | 114 | 81 | NA | 50 | 167 |
| *Daily treatment on development of LTF [dose/d]*[a] | | | | | | | | |
| Levodopa | 200 mg | 300 mg | 200 mg | 300 mg | − | 200 mg | 200 mg | 300 mg |
| Pramipexole (PRX) | 3 mg | 3 mg | 1.5 mg | − | − | 0.5 mg | 1.5 mg | − |
| Ropinirole (RP) | − | − | − | 6 mg | − | − | − | − |
| Rotigotine | − | 27 mg | − | − | − | − | − | 4.5 mg |
| Selegiline | − | − | − | 7.5 mg | − | − | 5 mg | − |
| Amantadine (AMT) | − | − | − | − | − | 100 mg | − | − |
| Trihexyphenidyl (TRX) | − | − | − | 4 mg | − | − | − | − |
| Zonisamide (ZNS) | − | 50 mg | − | − | − | − | 50 mg | − |
| Istradefylline | − | 20 mg | − | − | − | − | − | − |
| Dose modification within 6 months before abnormal posture | Increased dosage of PRX | Increased dosage of PRX | − | − | − | NA | − | Levodopa initiated and the dosage increased |
| Treatment | | | | | | | | |
| Antiparkinsonian drugs | Withdrawal of PRX, RP and zonisamide initiated, rotigotine increased (36 mg) | Rotigotine increased, zonisamide and istradefylline initiated | Levodopa increased (300 mg), rotigotine initiated and increased (18 mg) | − | − | Withdrawal of PRX | Withdrawal of PRX, selegiline initiated, rotigotine initiated and increased (27 mg) | Rotigotine increased (9 mg) |
| Rehabilitation during hospitalization | + | + | + | + | − | − | − | − |
| Outcome | Unchanged | Unchanged | Mildly decreased | Improved | Improved | Mildly decreased | Mildly decreased | Mildly decreased |

UPDRS: Unified Parkinson's Disease Rating Scale, LTF: lateral trunk flexion, NA: not available.
[a] At the CT examinations.
[b] Until the CT examination.
[c] 8 months ago.