



## Correspondence

## Internal and external compensation strategies to alleviate upper limb freezing in Parkinson's disease



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Freezing of gait (FOG) in Parkinson's disease (PD) is not restricted to walking [1]. Indeed, patients can also experience freezing in the upper limbs (FOUL) [2]. FOUL episodes and their associated motor changes are well correlated with FOG, for example in terms of the frequency of the trembling movements associated with the motor blocks [2]. However, although FOG and FOUL share such common characteristics, it is unclear whether they also have the same underlying pathophysiological mechanism [3]. External and internal cueing are effective compensation strategies to relieve FOG. External cueing (e.g. rhythmic auditory cues provided by metronome) can also alleviate FOUL, but the experience with this is very limited [4]. Moreover, the effectiveness of internal compensation strategies to alleviate FOUL has not been reported. Here, we present the effects of internal and external compensation strategies in a patient with both FOG and FOUL.

A 64-year-old woman with a 30-year history of PD (H&Y stage 4) was seen at our outpatient clinic. Her MDS-UPDRS III score was 40 while ON-medication, and 79 while OFF-medication. She experienced only biphasic dyskinesias, so there were no dyskinesias at the time of the peak dose effect. The patient was still markedly disabled even when experiencing an optimal ON effect, as reflected by the motor score of 40, hence dystonia and akinesia were still noticeable even during the ON phase. Despite optimal pharmacological and non-pharmacological treatment, she experienced FOG multiple times a day. Her gait improved markedly in the presence of external cueing (video 1). She reported that during FOG episodes, she not only experienced the typical feeling of the feet being glued to the floor, but also similar feelings in the upper limbs. Due to episodically occurring blocks in her upper limb movements, she was unable to use the brakes of her walker, which sometimes resulted in a fall (video 1). The 'freezing' sensation in the upper limbs associated with the trembling was also present during various other activities, e.g. when drawing with a pencil (video 2), closing a bottle (video 3), closing the zipper of a coat (video 3), when performing the finger tapping test, when embroidering, and when typing numbers on her mobile-phone. These episodes usually lasted only seconds during an ON phase (when dopaminergic medication was subjectively effective), but were considerably longer during OFF phases. Interestingly, she was able to overcome the FOUL-episodes by applying external and internal compensation strategies (video 2 and

3). Specifically, drawing was improved markedly by the presence of external auditory cues (video 2). Also, closing the bottle and closing the zipper improved by using internal compensation strategies, namely focusing purposely on specific parts of the task (video 3). For example, when closing the zipper, she first paid focused attention on bringing the two parts of the zipper together and then focused on pulling the zipper upwards. This latter strategy is also reminiscent of the 'chaining' strategy: splitting complex movements into smaller components that are each easier to perform.

Supplementary video related to this article can be found at <https://doi.org/10.1016/j.parkreldis.2019.03.008>.

There are several arguments why the observed upper limb deficits represent FOUL and not simply severe hypokinesia. First, the patient reported the same 'freezing' sensation during upper limb tasks as during FOG, where persons experience a characteristic and subjective feeling of the feet being "glued" to the floor. Although such subjective experiences are not the gold standard to define signs, they may help in the diagnostic process. Second, as with FOG, the motor disturbances were episodic in nature (motor performance clearly fluctuated within the task, with the presence of motor blocks), which is not typical for severe hypokinesia where one would have expected the movement to be executed in a slow but more or less continuous fashion. Third, freezing during the spiral-drawing task was associated with trembling in the 3–8 Hz band, which is also characteristically seen as the alternating trembling of the legs during a FOG episode [3].

Beneficial effects of external cueing strategies on FOUL have been described before [4] and are in line with the present observations. For the first time, we now show that internal attentional compensation strategies can also alleviate FOUL. Such internal strategies have been reported previously for FOG [5]. Patients with PD experience particular difficulties with controlling automatized movements, while the production of goal-directed movements is relatively spared. Internal and external cueing strategies likely enable patients to switch from automatic motor control to goal-directed motor control [6]. External auditory cues produce a rhythmic reference of target, which is predictive in nature. Internal cues, on the other hand, help to achieve focused attention on specific components of a motor task, as was applied by our patient when she closed the bottle and zipper. One may argue that

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upper limb tasks such as closing a bottle or the zipper of a coat are less automatic in nature than gait. We hypothesize, however, that the lines between fully automatic motor control and more goal-directed motor control are not strict, but that there is in fact a continuum of relatively more automatic motor control on the one hand, and relatively more goal-directed motor control on the other hand. Closing a bottle or the zipper of a coat might indeed be less automatic in nature than gait, but such commonly used and over-trained actions can still be executed in a largely automatic manner (e.g. most people are able to close a bottle while talking at the same time).

This case history also illustrates that FOUL episodes can be very disabling during daily life activities, and deserve tailored treatment. It is our impression that many patients do not report the presence of FOUL. It is therefore important to specifically ask patients for the possible presence of FOUL episodes in daily life situations, particularly when they also have FOG – which may draw the clinician's attention more easily. If FOUL is volunteered during the interview, we recommend to objectively verify its presence, e.g. by evaluating the spiral-drawing task or the funnel task. Subsequently, patients must be educated about compensation strategies by a physiotherapist with expertise in PD management.

#### Author roles

T.T.C.C., J.N. and B.R.B.: equally contribution: A. Conception, B. Organization, C. Execution; (2) Manuscript: A. Writing of the First Draft, B. Review and Critique.

E.R.B: contribution: A. Conception.

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#### Disclosure

None.

#### Consent

Signed informed consent for publication of the videos was obtained. This case report is in line with local ethical guidelines.

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