

# Seated Man Walking: A Provocation Maneuver for Parkinsonian Tremor

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Tremor is a classical clinical feature of Parkinson's disease (PD), typically occurring as tremor at rest.<sup>1</sup> Severity of tremor is related to the activities performed by patients; thus, mental stress, walking, or repetitive movements with another limb increase tremor amplitude, and provocation maneuvers are applied by clinicians in order to examine parkinsonian tremor.<sup>2</sup> Among these, walking is a frequent activation method to observe and enhance PD tremor. We report on a new clinical provocation maneuver, that is, simulation of walking in the sitting position, allowing the appearance of tremor undetectable in these conditions. The patient was a 67-year-old farmer with no family history of neurodegenerative disorders. In 2013, he experienced progressive motor impairment. Neurological examination showed small steps gait with reduced right-arm swing, hypomimic face, hypophonic voice, neck and upper limbs rigidity, diffuse bradykinesia, and right-hand resting tremor only present during walking. Other provocation maneuvers, such as backward counting, math calculation, and movement with another limb (either arms and legs), did not evoke tremor (see Video 1). He showed responsiveness to dopaminergic medication, and a diagnosis of PD was made.

The patient also underwent electrophysiological study. Tremor activity was recorded by electrodes positioned over the extensor carpi radialis and flexor carpi ulnaris muscles. An accelerometer was placed on the right index finger. Because tremor was present only during gait, not triggered by other maneuvers, and the electromyography (EMG) registration was not feasible in these conditions, we decided to record tremor activity with the patient sitting on a chair with the arm fully supported against gravity, while simulating walking. We recorded an alternating pattern of resting tremor, with a frequency of 5 Hz. Afterward, we applied this test on 4 more PD patients (2 males, 2 females; mean age: 58.5 years; range, 54–66). Three of four patients showed tremor during simulated walking as well as during gait (see Video 1).

Frequently, an exacerbation of the hand rest tremor is observed when asking parkinsonian patients to walk a short distance, as pointed out by Uchida et al.<sup>3</sup>

Several neuronal networks are involved in locomotion. The pedunculopontine nucleus (PPN) has an important role in initiation and maintenance of gait. It has been demonstrated that PPN is also engaged during limb movements and imagined gait.<sup>4</sup> Motor planning is physiologically promoted and started by parietal, premotor, and supplementary motor cortical areas, the same regions also involved in the generation of tremor, as described by Timmermann et al.<sup>5</sup> Besides, Bergman and Deuschl suggested that synchronous oscillating neuronal activity within the basal ganglia is responsible for parkinsonian symptoms and may be influenced and modulated by cerebellothalamic loop.<sup>6</sup> The simulation of walking might activate the common areas involved both in gait control and in generation of tremor, despite the lack of balance essential for locomotion. In the present series, an EMG recording of tremor has been obtained with patients in the sitting position and simulating walking because they did not show tremor in the standing and sitting positions. An accurate EMG evaluation of tremor during walking is technically difficult. The new method proposed here allowed either to provoke the tremor or to adequately record it.

The diagnostic value of this clinical maneuver could provide further suggestions to understand the mechanisms of provoked resting tremor in PD.

## Author Roles

(1) Research Project: A. Conception, B. Organization, C. Execution; (2) Statistical Analysis: A. Design, B. Execution, C. Review and Critique; (3) Manuscript Preparation: A. Writing of the First Draft, B. Review and Critique.

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## Supporting Information

A video accompanying this article is available in the supporting information here.

**Video 1.** Video depicts the PD patients' series reported in the text. The first case shows right-hand tremor only present during walking with the absence of resting tremor in the standing and sitting positions and during mental math calculation with closed eyes. Tremor is videotaped and EMG registered with the patient sitting on a chair with the arm supported against gravity, while simulating walking. The other cases presented a positive response to simulation of walking, with the exception of the fourth, who did not show activation of tremor during gait nor simulating a walking maneuver. Only the fifth patient had tremor activated also by a mentally demanding task.