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Case report

Shopping bag tremor: insights from kinematic analysis

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ABSTRACT

Background: Shopping bag tremor (SBT) is a rare activation-specific tremor characterized by weight-dependent oscillations, with uncertain nosological classification.
Case Report: We report a 74-year-old woman with a right upper limb tremor triggered by carrying a shopping bag, with mild rest component. Kinematic analysis demonstrated a non-linear load–response relationship, with low tremor amplitude when unloaded, maximal at low loads (1 kg), and progressively decreasing as weight increased. No abnormalities were detected on finger tapping analysis.
Discussion: This case expands the phenotypic spectrum of SBT and supports quantitative kinematic analysis as a feasible first-line tool within diagnostic algorithms for complex tremor presentations.

1. Introduction

Shopping bag tremor (SBT), also referred to as "weight-holding tremor", represents a rare and diagnostically challenging activation-specific tremor phenotype characterized by rhythmic oscillations emerging predominantly during sustained weight bearing under isometric conditions (Keshav et al., 2026) (Bhatia et al., 2018). Since its original description, SBT has remained difficult to classify and has been variably interpreted as a task-specific variant of essential tremor (Lang et al., 1995), a subtype of isometric tremor (Keshav et al., 2026; Robakis and Louis, 2014; Villa-López et al., 2021; Yong et al., 2020; Zesiewicz et al., 2014) or an atypical prediagnostic manifestation of Parkinson's disease (PD) (Meira et al., 2020). More recent electrophysiological investigations have emphasized the non-linear interaction between mechanical load and tremor amplitude, suggesting that SBT encompasses a broader phenotypic variability (Keshav et al., 2026). These observations raise the possibility that isometric contraction alone may not fully account for tremor emergence in this condition, and that task- and position-specific mechanisms, possibly related to grip configuration and associated sensorimotor context, may contribute to its manifestation.

2. Case report

A 74-year-old right-handed woman presented with an 18-month history of a right-sided upper limb tremor, almost exclusively triggered by weight-holding activities such as carrying shopping bags, with no significant interference in other activities of daily living. Her past medical history included arterial hypertension, subclinical hypothyroidism, and osteoporosis. She denied hyposmia, REM sleep behavior disorder, or other non-motor symptoms suggestive of prodromal parkinsonism. Family history was negative for neurological disorders. At the time of evaluation, the patient was not receiving any treatment for tremor. Brain MRI showed mild-to-moderate chronic small-vessel ischemic leukoencephalopathy (Fig. 1). The patient declined DAT-SPECT and other additional diagnostic assessments.

Neurological examination revealed an intermittent, low-amplitude rest tremor of the right upper limb, together with a right-sided walking tremor, reduced right arm swing and a questionable dystonic posturing of the right hand. Tremor amplitude increased during weight holding (e.g., when carrying a handbag), with maximal expression at lower loads and progressive attenuation with increasing weight. Notably, tremor emerged predominantly when the patient adopted a semi-open "J-shaped" grip with flexion of the distal phalanges. A subtle tremor component was also detectable while holding an empty bag and when mimicking the same grip without the bag (Supplementary Video

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S1). No other neurological abnormalities were observed.

Following a standardized protocol, kinematic recordings were obtained using an optoelectronic motion capture system, as described in previous studies (Angelini et al., 2024; Birreci et al., 2025). The kinematic assessment included recordings of rest, postural, and kinetic tremor, followed by a systematic evaluation of weight-holding conditions using a shopping bag loaded with 1, 3, and 5 kg. Recordings were performed using the semi-open "J-shaped" grip, with flexion of the distal phalanges. Additional recordings were obtained while holding an empty bag and while mimicking identical hand postures without the bag, as well as during forward arm extension with 1-kg wrist weights. As adopted in previous studies, kinematic analysis was also used to assess possible movement abnormalities during finger tapping (Paparella et al., 2025).

Quantitative kinematic measures are summarized in Table 1. Tremor amplitude demonstrated a non-linear dependence on load, with a clear peak at low weight (approximately 1 kg) followed by progressive attenuation at higher loads (3 and 5 kg) (Fig. 2), showing a response pattern in line with those reported in other cases of weight-holding tremor (Keshav et al., 2026).

Oscillatory activity was also detectable in the empty-bag and grip-mimicking conditions, although with markedly lower RMS values compared with the 1-kg peak. Low-amplitude oscillatory activity was also recorded at rest, with RMS values comparable to those observed in the grip-mimicking condition. Tremor frequency remained stable across experimental conditions, ranging between 5.5 and 6 Hz. Finger tapping analysis revealed no clear abnormalities when compared with previously published reference values (Paparella et al., 2025).

3. Discussion

The novelty of this case lies in the systematic kinematic characterization of the SBT pattern and additional motor features, complementing clinical assessment with objective quantitative data. The

Table 1
Kinematic measures of tremor and finger tapping in the reported case.

Tremor analysis		
	Right	
	RMS	**Frequency (Hz)**
Postural tremor	–	–
Rest tremor	0.024	5.5
Kinetic tremor	–	–
Wrist load (1 kg)	–	–
Shopping bag (1 kg)	0.235	6.0
Shopping bag (3 kg)	0.131	6.0
Shopping bag (5 kg)	0.106	5.5
Empty shopping bag	0.053	5.5
Grip without bag	0.023	5.5
Finger tapping analysis		
	Right	**Left**
N° mov	49	43
Velocity	1066.323	1050.251
Amplitude	49.82	57.113
CV	0.097	0.123
Velocity slope	−4.7	−6.389
Amplitude slope	−0.194	−0.309

Abbreviations: RMS, root mean square; N° mov, number of movements; CV, coefficient of variation of inter-tap intervals, reflecting movement rhythm. Tremor was identified only on the right side. Tremor amplitude is expressed by the RMS of the acceleration traces of the reference markers in three-dimensional space. Tremor frequency refers to the dominant frequency peak identified on the power spectrum obtained through fast Fourier transform and is expressed in Hz. Movement velocity and amplitude are expressed in degrees/s and degrees, respectively. Velocity and amplitude slopes are expressed in (degrees/s)/N° mov and degree/N° mov, respectively. Normative values for healthy subjects are reported as mean ± SD: N° mov, 46.26 ± 16.41; movement velocity, 1080.80 ± 252.8 degrees/s; movement amplitude, 49.93 ± 13.48 degrees; movement rhythm (CV), 0.09 ± 0.03; velocity slope, −6.39 ± 4.73 (degrees/s)/N° mov; amplitude slope, −0.13 ± 0.21 degree/N° mov.

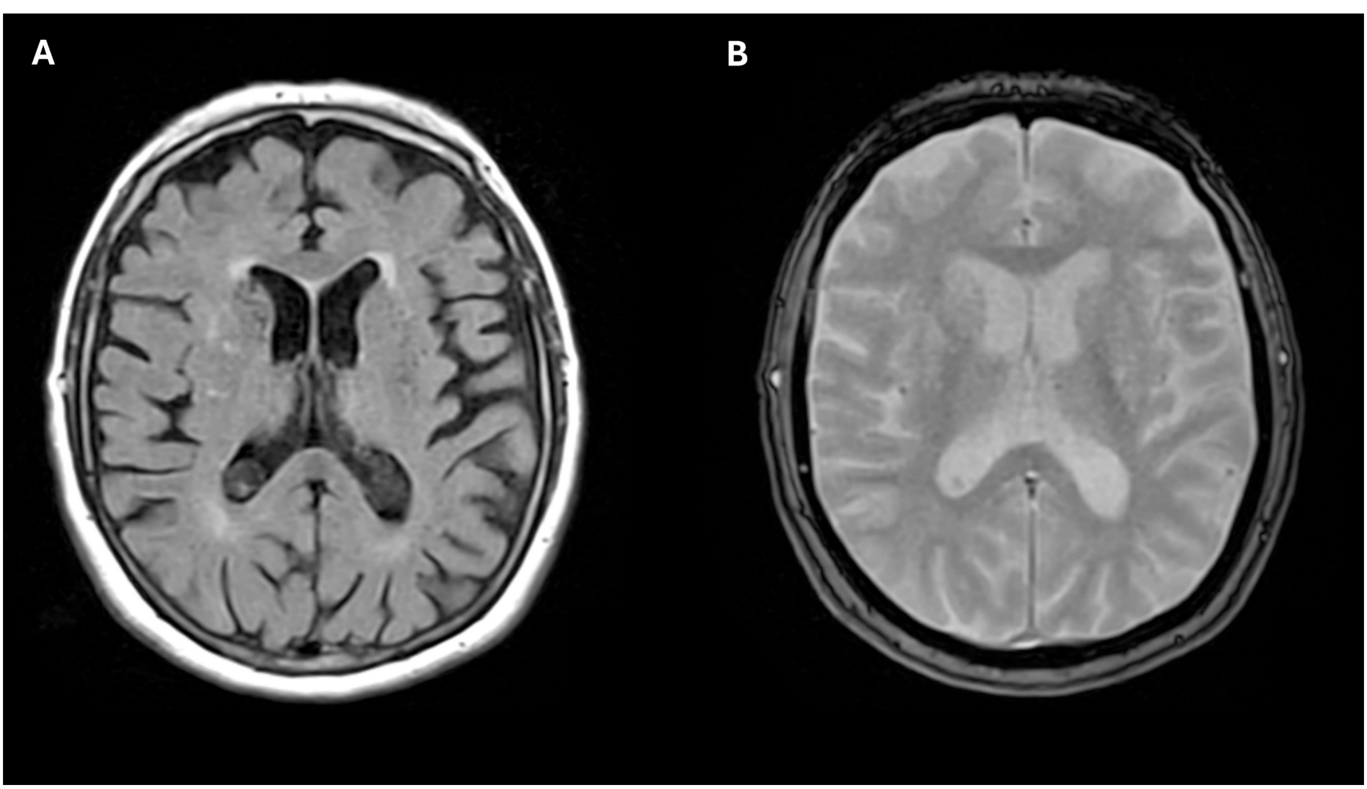

Fig. 1. Brain MRI data A: Axial fluid-attenuated inversion recovery (FLAIR) sequence, revealing mild-to-moderate chronic small-vessel ischemic leukoencephalopathy without focal abnormalities. B: Gradient-echo (GE) sequence, showing no evidence of haemorrhagic lesions or other significant abnormalities.

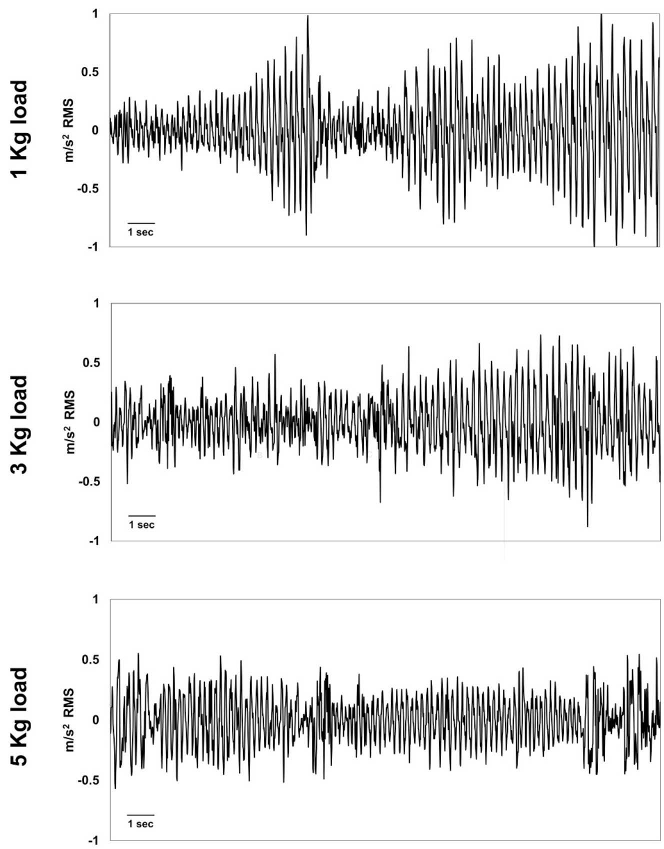

Fig. 2. Kinematic tremor traces Kinematic traces of tremor amplitude recorded with a J-shaped grip while holding a shopping bag loaded with 1 kg, 3 kg, and 5 kg, expressed as an acceleration signal (m/s^2). The root mean square (RMS) of these traces reflects the magnitude of oscillatory acceleration over time and provides a quantitative estimate of tremor amplitude.

phenomenology observed in our patient shares several key features with previously reported cases of shopping bag tremor, with tremor expression critically dependent on both hand configuration and load magnitude. Consistent with prior observations, tremor amplitude was maximal with a semi-open grip and markedly attenuated with a tight fist (Meira et al., 2020; Robakis and Louis, 2014; Zesiewicz et al., 2014). This observation suggests that grip-related factors, such as the degree of muscle co-contraction and the distribution of force across the fingers, may play a relevant role in modulating tremor expression. Importantly, the systematic kinematic analysis performed in the present case allowed a detailed characterization of load dependency, demonstrating a non-linear, bell-shaped load–response profile. Across conditions, tremor frequency remained relatively stable, suggesting that rest and weight-holding oscillations may share common oscillatory features. Tremor amplitude was mild in the unloaded condition, reached maximal expression at low loads (1 kg), and progressively attenuated as the weight increased. While some studies have described similarly non-linear load–response patterns (Keshav et al., 2026), other reports have shown a progressive increase in tremor amplitude at heavier weights (Yong et al., 2020; Zesiewicz et al., 2014), underscoring the phenotypic variability of weight-holding tremor. Such variability suggests that load acts not merely as a generic isometric trigger, but as a modulator of tremor expression, potentially through sensorimotor modulation during sustained weight bearing. In this context, recruitment of short- and long-loop reflex pathways may contribute to the non-linear load–response profile, with low-to-intermediate loads facilitating tremor expression and higher loads increasing co-contraction and mechanical stabilization. Notably, tremor was selectively modulated by the act of holding a weighted object, whereas the same load applied under alternative isometric conditions, such as wrist loading during forward arm extension, failed to elicit tremor. This dissociation indicates that tremor emergence is not driven by weight alone but requires a specific positional and sensorimotor context of load bearing. Accordingly, the observed pattern may depend on the interaction between load magnitude, grip configuration, reflex modulation, and sensorimotor control, supporting a phenotype in which isometric and position-dependent components overlap. At the same time, the lack of skill dependency and cognitive engagement indicates that this phenomenon is not entirely typical of canonical task-specific tremors (Bain, 2011).

Furthermore, while some published cases have reported a mild action tremor, rest tremor has been only rarely described in this context (Meira et al., 2020; Lang et al., 1995). In our patient, the combination of a mild intermittent rest tremor, reduced right arm swing and a walking tremor may suggest an underlying parkinsonian syndrome, which cannot be completely excluded in the absence of DAT-SPECT or other supportive diagnostic investigations. This represents a limitation of the present report and leaves residual uncertainty regarding the underlying diagnosis. However, this interpretation requires caution, since similar parkinsonian-like features have also been reported in dystonic tremor phenotypes (Schneider et al., 2007). In this context, quantitative kinematic assessment provided an additional perspective, as finger-tapping parameters fell within the normative range of healthy subjects and did not show abnormalities consistent with the “bradykinesia complex”. This multidimensional assessment considers distinct bradykinesia-related motor abnormalities, including movement slowness, hypokinesia, dysrhythmia, and sequence effect (Paparella et al., 2025). Taken together, these observations support an integrated clinical and kinematic approach in complex tremor presentations, enabling objective characterization of motor features and tremor patterns, and promoting kinematic assessment as a feasible first-line extension of clinical evaluation.

In conclusion, shopping bag tremor may reflect an abnormal load- and position-dependent modulation of tremor amplitude. Despite previously published reports, continued clinical characterization of additional cases remains essential to better delineate the phenomenological heterogeneity of this condition and to address the diagnostic challenges it may pose. Systematic application of quantitative kinematic approaches may help define reproducible response patterns, support phenotypic stratification, and improve diagnostic work-up in challenging tremor presentations. Longitudinal follow-up of such cases will be essential to determine whether these presentations represent stable tremor phenotypes or early manifestations of an evolving neurodegenerative disorder.

Supplementary data to this article can be found online at https://doi.org/10.1016/j.cnp.2026.07.002.

Author contribution

(1) Research project: A. Conception, B. Organization, C. Execution; (2) Statistical Analysis: A. Design, B. Execution, C. Review and Critique; (3) Manuscript: A. Writing of the first draft, B. Review and Critique:

DB: 1 A, 1B, 1C, 3 A.
SA: 1C, 3B.
ASG: 3B.
MDR: 3B.
LA: 3B.
AC: 3B.
MB: 1 A, 1B, 3B.

Ethical compliance statement

The authors confirm that approval of an institutional review board or ethics committee was not required for this case report. All procedures performed were in accordance with the ethical standards of our institution, and with the Helsinki Declaration. Written informed consent was obtained from the patient for the publication of her data and the online distribution of the related video material. We confirm that we have read the journal's position on issues involved in ethical publication and affirm that this work is consistent with those guidelines.

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The authors declare that they have no financial disclosures to declare.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Data availability statement

The data that support the findings of this case report are available from the corresponding author upon reasonable request.

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