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**CASE REPORT**

# Functional Outcomes of Task-Oriented Circuit Training in a Middle-Aged Male with Vascular Parkinsonism and Recurrent Stroke: A Case Report

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## ABSTRACT

**Introduction:** Vascular parkinsonism (VP) due to small-vessel disease markedly impairs mobility and quality of life. As VP patients respond poorly to dopaminergic therapy, structured exercise rehabilitation is essential. This case report examines the functional outcomes of a six-week task-oriented circuit training (TOCT) program in a 59-year-old man with chronic VP (>6 months, four prior events).

**Case Description:** A 59-year-old male with VP from recurrent ischemic infarcts presented with gait unsteadiness, bradykinesia, and limited community ambulation. A six-week rehabilitation program centered on TOCT, integrating balance, gait, and functional task practice, was implemented. This was supplemented with aerobic conditioning and stretching. Post-intervention assessment revealed improvements in balance, walking endurance, pain reduction, and functional independence.

**Discussion:** The structured TOCT protocol, emphasizing high repetition of task-specific movements and progressive challenges, effectively addressed the postural instability and endurance deficits characteristic of VP. The combination of TOCT with aerobic exercise provided a comprehensive approach to improve motor performance and patient-reported outcomes.

**Conclusions:** An individualized six-week multidisciplinary rehabilitation program improved balance, endurance, pain, and QoL in a patient with VP; however, these findings are limited by the descriptive single-case design and require confirmation in larger, randomized, and blinded studies.

**Keywords:** quality of life, rehabilitation, small vessel disease, stroke, TOCT, vascular parkinsonism.

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# INTRODUCTION

Vascular parkinsonism (VP) is an acquired form of parkinsonian syndrome caused by cerebrovascular lesions such as small-vessel ischemic strokes.[1] It often manifests as lower-body parkinsonism with predominant gait and balance impairment and minimal tremor.[2] These mobility deficits severely limit function, and QoL is markedly reduced in VP patients.[1] Because VP patients typically respond poorly to dopaminergic therapy, tailored rehabilitation is needed to address their balance and endurance impairments. Unlike idiopathic Parkinson's disease (PD), where dopaminergic therapy and targeted exercise can yield marked improvement, VP often shows poor pharmacologic response, and slower rehabilitation gains due to underlying vascular and white matter pathology. Therefore, individualized rehabilitation approaches that emphasize balance and endurance training are critical for optimizing function in VP patients.[1,3]

Although specific rehab protocols for VP are under-reported, evidence from related populations suggests benefit from structured exercise. In Parkinson's disease (PD), systematic reviews show that regular exercise (especially aerobic training), significantly improves overall QoL.[3] However, the rehabilitation profile of VP differs: while PD patients often respond to cueing and rhythmic strategies that engage basal ganglia circuits, VP rehabilitation requires compensatory mechanisms emphasizing postural control, endurance, and adaptive task practice.[1,3] Likewise, task-oriented circuit training (TOCT) has demonstrated functional gains: a recent randomized trial found that a TOCT program improved motor performance, activities of daily living, and QoL in PD patients.[4] In other neurologic conditions, combining TOCT with conventional therapy also yields larger gains in gait and endurance than standard care alone.[5] These findings support a multidisciplinary, task-focused regimen to target balance, walking endurance, and patient-perceived health.

In this case report we applied a combined exercise regimen of TOCT plus aerobic conditioning to a 59-year-old man with chronic VP secondary to small-vessel strokes. Over six weeks he underwent individualized circuit training of TOCT plus aerobic conditioning. This case highlights the value of a structured, reproducible framework for rehabilitation in vascular parkinsonism, addressing the limited detail of existing programs. This case aimed to evaluate whether TOCT combined with aerobic conditioning could enhance balance, endurance, and quality of life in a patient with chronic VP and to underscore the need for further studies to define optimal intensity, long-term outcomes, and real-world applicability of such interventions.

## PRESENTATION/CASE DESCRIPTION

A 59-year-old male was referred from neurology with a chronic-phase diagnosis of vascular parkinsonism secondary to small-vessel cerebrovascular disease and four prior ischemic infarct events (2015, 2021, April 2022, and June 2024). Magnetic resonance imaging (MRI) result demonstrated multiple chronic lacunar infarcts involving subcortical and periventricular regions, with additional chronic ischemic changes in the thalamus and midbrain, white matter hyperintensities, and generalized cerebral atrophy. The patient reported a three-year history of persistent gait unsteadiness and positional dizziness, progressive bradykinesia and slowed speech since the 2022 event, a history of intermittent drooling which had resolved, a persistent left-sided ptosis after the 2024 stroke, and activity-provoked posterior right-thigh pain. Functionally, he was independent for basic household tasks but had severely limited community ambulation, inability to reliably walk more than 100 meters, and consequent restrictions in driving and community participation.

Outcome measures included Montreal Cognitive Assessment-Indonesian version (MoCA-INA), Berg Balance Scale (BBS), Visual Analog Scale (VAS), six-minute walk test (6MWT), dan Patient-Reported Outcomes Measurement Information System (PROMIS) Global Health. Baseline clinical assessment found mild cognitive impairment on the MoCA-INA 23/30, with deficits most pronounced in visuospatial/executive function, attention, and language domains. Motor examination revealed prominent lower-body rigidity with lead-pipe tone at the hips, knees and ankles, absence of spasticity (Modified Ashworth Scale 0), and bradykinesia contributing to slow gait and delayed activities of daily living. Postural inspection (Figure 1) showed forward head posture, hip flexion with posterior pelvic tilt, and a slight lateral trunk deviation to the left. Instrumented and patient-reported outcome measures included the BBS 41/56, indicating moderate fall risk; a VAS for

posterior right-thigh pain approximately 4/10 during prolonged sitting or ambulation; markedly reduced walking endurance with exertional fatigability after approximately 100 meters; and PROMIS Global Health scores with Physical Health 39.8 and Mental Health 48.3.

A goal-oriented, multidisciplinary rehabilitation program was prescribed to improve gait performance, cardiorespiratory endurance, reduce pain, and preserve functional independence. The intervention consisted of supervised, clinic-based therapy three times per week for six weeks with formal reassessments every two weeks. Adherence to the home program was monitored daily by the patient using an exercise log that was reviewed by the treating therapist at each clinic visit. Clinic-based therapy combined TOCT that emphasized balance pad activities, stair walking, and walking with obstacles. The aerobic exercise prescribed at the clinic was performed twice per week at a low intensity corresponding to thirty to forty percent heart rate reserve for thirty minutes per session using a leg ergo cycle with progression of an additional five minutes per week as tolerated. Adjunctive management included targeted stretching of the bilateral hamstrings and the gastrocnemius-soleus complex to address musculoskeletal contributors to pain. The structured home program was consisted of daily balance exercises with clear progression, activity-modification strategies, and light-intensity aerobic sessions (walking or ergo cycle) to be performed at least five times per week using the talk test for thirty minutes per session using a leg or arm ergo cycle. Adjunctive physiotherapy addressed musculoskeletal contributors to pain with supervised sessions. Physiotherapy performed twice per week included hamstring stretching of both legs and stretching of both the gastrocnemius and soleus muscles. The patient was also instructed to continue stretching at home. Home stretching consisted of hamstring stretching of both legs and gastrocnemius and soleus stretching of both legs.

At the six-week reassessment the patient completed the program without adverse events and demonstrated both objective and patient-reported improvement. The 6MWT distance improved by approximately 30 percent from baseline, BBS increased from 41/56 to 43/56, and VAS pain decreased from 4/10 to 2/10. The PROMIS Global Health scores improved, with Physical Health rising from 39.8 to 44.9 and Mental Health from 48.3 to 50.8. Cognitive screening remained stable (MoCA-INA 23/30) (Table 1). Clinically, the patient reported reduced dizziness while ambulating, decreased exertional fatigue, less posterior thigh pain during prolonged sitting and walking, and increased independence in activities of daily living, for example greater confidence with household mobility and reduced need to interrupt activities to rest. These objective measures and the patient's self-reported outcomes demonstrate clear improvements in balance, walking endurance, pain, and functional independence from baseline to the six-week reassessment in this single patient.

**Table 1.** Patient outcome measurements.

| Measure | Baseline | After 6 weeks | Δ |
|---|---|---|---|
| BBS | 41/56 | 43/56 | +2 |
| VAS | 4/10 | 2/10 | -2 |
| PROMIS-Physical | 39.8 | 44.9 | +5.1 |
| PROMIS-Mental | 48.3 | 50.8 | +2.5 |

## DISCUSSION

In this VP case, a six-week program of TOCT combined with aerobic exercise yielded modest but meaningful improvements in balance, gait endurance, and patient-reported health. Although the Berg Balance Scale (BBS) increased by only 2 points (41 → 43), which is smaller than many anchor-based estimates of the minimal clinically important difference (MCID) reported for stroke and similar neurologic populations, distribution-based approaches and several recent studies indicate that smaller changes (≈2–5 points) can still reflect real improvements when considered together with other outcomes (for example a ~30% increase in 6MWT and improved patient-reported function and pain). The MCID for BBS varies with baseline severity and method used to calculate it, so a modest absolute BBS gain in a patient with moderate baseline impairment may translate into meaningful functional change, reduced fatigability during walking, and greater confidence during activities of daily living.[6,7]

These combined improvements (BBS + 6MWT gain + PROMIS changes and symptom report) therefore support a functionally relevant rehabilitation effect despite the small absolute BBS change. These gains highlight the rehabilitation strategies that specifically address postural instability, which is a core and disabling feature of vascular parkinsonism. In this patient, baseline examination showed the classic

features of VP (predominant gait and balance deficits, minimal tremor, lead-pipe lower limb rigidity). Because VP patients seldom benefit from medications, tailored rehabilitation that directly targets postural and endurance deficits is essential.[6]

Our intervention used the same core elements that have been demonstrated effective in idiopathic PD, namely TOCT combined with aerobic conditioning. In PD, goal-oriented circuit training plus aerobic conditioning has demonstrated improvements in balance, gait, and overall function. For example, Soke et al. found that PD patients receiving TOCT combined with aerobic exercise had significantly greater gains in BBS, 6MWT, and QoL compared to aerobic training alone.[8] Likewise, numerous PD trials and meta-analyses report that exercises emphasizing gait, balance, and endurance produce moderate improvements in motor symptoms and quality of life.[9]

High-quality trials in PD demonstrate that pairing large volumes of task-specific practice within a circuit format with aerobic conditioning improves balance, walking endurance, and patient-reported function. Given the limited availability of VP-specific randomized trials, it is reasonable to adapt those PD-derived principles to VP while calibrating intensity and progression to the patient's deficits and tolerance.[8,10,11] Mechanistically, aerobic conditioning likely increased cardiovascular reserve and delayed exertional fatigue, which is consistent with the observed 6MWT gains and reduced bradykinetic slowing during sustained ambulation. Concurrently, repetitive balance and stepping practice within a structured circuit yields high repetition of task-relevant movements, graded challenge progression, and integrated cognitive-motor demands that support motor learning and neuromuscular coordination.[10,12–14] These features explain why a structured, progressive, TOCT plus aerobic work is a rational rehabilitative strategy for addressing the multifactorial gait impairments of VP.[6]

The reduction in posterior thigh pain (VAS 4 to 2) may reflect both biomechanical and flexibility-related changes. In this case, postural inspection documented hip flexion with posterior pelvic tilt, a pattern that can be associated with functional limitation of hip extension and increased tension through the posterior thigh and proximal hamstrings. For this reason, targeted stretching of the bilateral hamstrings and the gastrocnemius–soleus complex was specifically included to address those musculoskeletal contributors. Notably, the program was well tolerated: the patient completed all sessions without adverse events, consistent with the high safety profile of exercise interventions in parkinsonian populations.[9,15,16]

Cognitive screening (MoCA-INA 23/30) remained stable after six weeks. This finding is unsurprising given the brief duration of the intervention and its primary focus on motor and endurance training; measurable improvements in attention, executive function, or language typically require either longer interventions, larger samples, or interventions with an explicit cognitive-training component. Importantly, the program was well tolerated and produced clinically meaningful gains in balance, walking endurance, pain, and patient-reported physical and mental health. These outcomes support the value of rehabilitation for improving functional capacity in chronic vascular parkinsonism, while highlighting that cognitive outcomes may necessitate targeted or longer-term strategies.[9,17]

A patient with chronic vascular parkinsonism received a structured TOCT program combined with aerobic conditioning and demonstrated measurable improvements in balance, walking endurance, pain, and self-reported health. This approach is not presented as a novel therapeutic modality but as a reasoned adaptation of rehabilitative principles established in idiopathic Parkinson disease to a VP population in which randomized, disease specific trials remain scarce. It is important to distinguish VP from idiopathic PD because VP more commonly presents with lower body predominant gait and postural instability, variable cognitive impairment related to cerebrovascular disease, and generally lower levodopa responsiveness, all of which influence prognosis and realistic therapy goals.[2,6]

This report is limited by its single-case, uncontrolled design, short follow-up (six weeks), and reliance on clinic-based outcome measurement without long-term functional or activity-monitoring data. The small absolute change in BBS (2 points) falls below many anchor-based MCID estimates reported in stroke and neurologic samples and therefore might reflect measurement variability for a single patient; however, distribution-based estimates and concordant large gains in 6MWT and patient-reported outcomes increase confidence in a true effect (see above). The program's adherence data relied in part on self-report (exercise log) and the intervention combined multiple components (TOCT, aerobic conditioning, stretching), so the relative contribution of each element cannot be disentangled. Imaging and severity of cerebrovascular disease were described but not quantified for

correlation with outcomes. Finally, generalizability is limited findings should be confirmed in larger, randomized, and preferably blinded trials with longer follow-up, objective activity monitoring (e.g., step counters / wearable sensors), and prespecified MCID thresholds for balance outcomes.[7,18]

Rehabilitation can still exploit preserved motor learning capacity, compensatory strategies, and peripheral conditioning to improve endurance and task performance. For that reason, the intervention emphasized high repetition of task relevant practice, graded postural and obstacle challenges, dual task training to integrate cognitive motor demands, and aerobic work to increase cardiovascular reserve and delay exertional fatigue. These elements are supported by trials and systematic reviews in Parkinson disease showing benefits from TOCT and aerobic conditioning and by evidence that multidisciplinary movement training can improve mobility in parkinsonian syndromes. Clinically this suggests that even in chronic VP, structured progressive and individually calibrated rehabilitation can yield clinically meaningful improvements in activity and participation, while expectations should focus on functional compensation and maintenance rather than disease modification. Future research should evaluate optimal dosing, durability of gains, and strategies to translate short term improvements into sustained community participation.[8,10]

## CONCLUSION

A six-week, goal-oriented rehabilitation program combining functional circuit training and aerobic exercise was associated with measurable gains in balance, walking endurance, and self-reported health in this patient with vascular parkinsonism. These improvements, in the context of VP's usual resistance to medication, underscore the importance of emphasizing physical therapy in VP management.[6] The results align with evidence from Parkinson's disease that task-specific and endurance exercise can improve gait, balance and quality of life.[8,9]

Clinically, providers may consider TOCT as a feasible and safe adjunct to usual care for patients with vascular parkinsonism, particularly for those with limited response to dopaminergic therapy while recognizing that larger, controlled studies are needed before broad implementation. Although derived from a single case, this experience suggests that rehabilitation offers a viable strategy to enhance function and well-being in vascular parkinsonism. Further controlled studies are needed to confirm these effects and refine optimal training regimens.[8]

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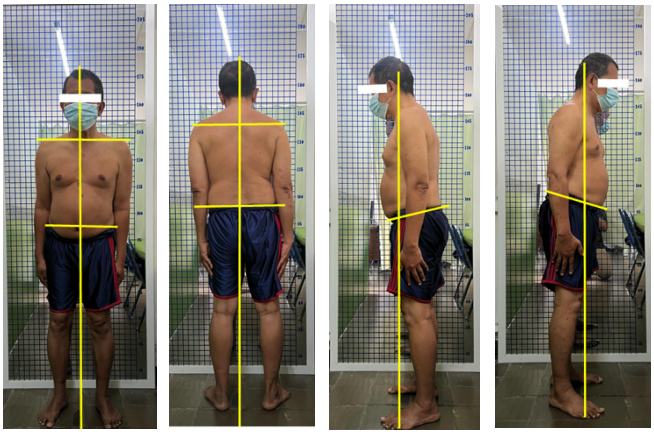

**Figure 1. Postural Inspection**

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