WebLog Journal of Physical Therapy and Rehabilitation

Case Report
Published: 25 Nov, 2025

Comprehensive Physiotherapy Management in a Patient with Acute Stroke Secondary to Moya Moya Disease: A Case Report

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WebLog Open Access Publications
Article ID : wjptr.2025.k2501
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Received Date: *16 Nov 2025*
Accepted Date: *24 Nov 2025*
Published Date: *25 Nov 2025*

Citation:
Ayn R, Dhargave P, James TT. Comprehensive Physiotherapy Management in a Patient with Acute Stroke Secondary to Moya Moya Disease: A Case Report. WebLog J Phys Ther Rehabil. wjptr.2025.k2501. https://doi.org/10.5281/zenodo.17844312

Introduction

Moya Moya Disease (MMD) is a rare, chronic, and progressive cerebrovascular disorder characterized by the bilateral, stenotic occlusion of the terminal portions of the internal carotid arteries and the proximal parts of the anterior and middle cerebral arteries [1]. This progressive narrowing leads to the formation of a fine, collateral vascular network at the base of the brain, visualized on angiography as a "puff of smoke"—the Japanese term from which the disease derives its name [2]. The resultant chronic cerebral hypoperfusion can precipitate both ischemic events (transient ischemic attacks or strokes) and haemorrhagic strokes due to the fragility of the compensatory collateral vessels [3].

The clinical presentation of MMD varies widely based on the dominant pathology. Ischemic presentations typically manifest as recurrent transient ischemic attacks (TIAs) exacerbated by hyperventilation, headache, or progressive neurological deficits, including hemiparesis, cognitive decline, or seizures [4]. Definitive treatment often involves medical management primarily focuses on symptom control and surgical revascularization aimed at improving cerebral blood flow and reducing the risk of future events [5].

Despite optimal medical and surgical intervention, patients often present with significant residual neurological impairments following a stroke, which necessitates intensive neurorehabilitation. Physiotherapy plays a critical role in addressing the sequelae of an Upper Motor Neuron (UMN) lesion, including spasticity, paresis, and functional mobility deficits. While MMD is a specific and distinct vasculopathy, the resulting motor impairment patterns often resemble those of conventional stroke, demanding evidence-based, goal-oriented rehabilitation [6]. However, the literature is sparse regarding detailed, measurable physiotherapy protocols and their efficacy specifically in patients recovering from MMD-related stroke, especially those presenting with complex bilateral motor and cranial nerve involvement. This case report aims to detail the comprehensive physiotherapy management of a patient diagnosed with MMD, demonstrating significant functional and neurological recovery over a short, intensive period.

Case Report

Patient Presentation and Initial Assessment

The patient, a 45-year-old male, presented following a confirmed stroke secondary to Moya Moya Disease, with significant right hemisphere involvement leading to left-sided hemiparesis (Figure 1). Upon initial assessment, the patient was fully conscious (Glasgow Coma Scale: 15/15) and oriented. Speech was compromised by dysarthria. Cranial nerve examination revealed complex bilateral deficits: a right-sided ptosis (CN III) and a left-sided Upper Motor Neuron (UMN) facial palsy (CN VII).

The motor examination highlighted pronounced impairments. Muscle tone in the left upper and lower extremities was markedly increased (Modified Ashworth Scale [MAS] Grade 3), consistent with significant spasticity. Strength testing (Manual Muscle Testing [MMT]) was severely compromised on the left, with the shoulder, elbow, and wrist grading 1/5 (trace contraction), and the hip grading 0/5 (complete paralysis). The patient also exhibited moderate paresis in the right extremities (MMT 3/5 across the upper and lower limb groups), suggesting involvement from diaschisis or

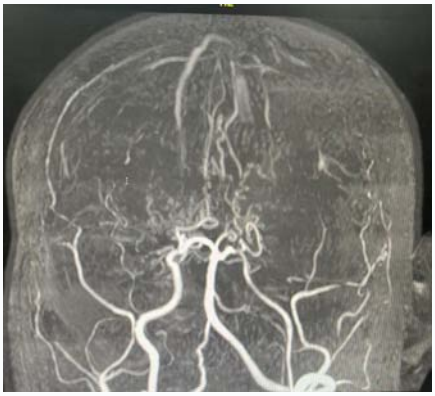

Figure 1: MRI findings confirming diagnosis of Moya Moya Disease.

contralateral hemispheric insult. The left upper limb displayed a typical flexor synergy pattern (shoulder elevation, elbow flexion) and poor scapular stability. Gait was non-functional, characterized by a severe left hemiplegic pattern with hip hiking and circumduction. Initial functional assessments confirmed severe dependence: the Berg Balance Scale (BBS) score was 17/56 (wheelchair bound), the Functional Independence Measure (FIM) was 39/126, and the Timed Up and Go (TUG) test recorded 30 seconds. House Brackmann scale grade IV- moderately severe dysfunction.

Physiotherapeutic Framework

The rehabilitation approach followed an integrated neurorehabilitation model, combining the Neurodevelopmental Treatment (NDT) framework, Motor Relearning Programme (MRP), and Task-Oriented Training (TOT) within the constraints of Moya Moya disease physiology. Each intervention was guided by the principles of activity-dependent neuroplasticity.

During the first week, the focus is on reducing abnormal tone and establishing early postural stability. Sessions are performed in 15–20-minute bouts, 3 times per day, using reflex inhibiting positions for the upper and lower limbs to calm gamma motor activity. Slow rotational joint movements and 3–4 bouts of 5-minute left-side weight-bearing help inhibit tonic stretch reflexes. Scapulothoracic mobilization (10–12 slow reps) restores proper scapular rhythm, while diaphragmatic breathing (5-minute cycles, 2–3 times/day) supports autonomic regulation. Early trunk activation such as segmental rolling, bridging, and supported sitting help to build proximal stability before progressing to limb work, with rest between sets to prevent cerebral hypoperfusion.

During the second week, training focuses on active cortical recruitment and bilateral motor integration, performed in 15–25-minute sessions, 3 times per day. Mirror therapy and bilateral arm training are practiced for 15 minutes to enhance interhemispheric synchronization. Upper and lower limb PNF is applied using rhythmic initiation, slow reversals, and hold-relax techniques. Trunk stabilization progresses to dynamic sitting, multidirectional reaching, and bridging with pelvic tilts for 3 sets of 10 reps. Supported standing and pre-gait practice to improve postural reactions. Upper-limb task-specific training such as reaching, grasping, and object manipulation were performed, while isotonic strengthening was done using elastic bands. Facial rehabilitation uses brief 5-minute proprioceptive neuromuscular facilitation along with mirror therapy, 3 times daily.

In the third week, therapy shifts to task-oriented functional recovery with 20–30-minute sessions, 3 times per day, emphasizing real-world motor integration. Overground gait training is practiced for 10 minutes with facilitation of pelvic motion and knee control, using an AFO as needed for safe dorsiflexion. Dynamic balance retraining such as multidirectional weight shifts, perturbations, sit-to-stand, and step-ups were performed in 3 sets of 10 repetitions. Functional strengthening uses low-load, high-rep closed-chain exercises (mini-squats, wall slides, partial lunges) completed in 3 sets of 10 reps. Dual-task walking is introduced in 3–5 short bouts to improve cognitive-motor coupling. Fine motor control is refined through dexterity tasks for 10 minutes, and ADL retraining (grooming, dressing) is practiced daily. Endurance is maintained through 5–10-minute bouts of low-intensity walking (RPE 3–4/10) to safely support cardiovascular and cerebral perfusion.

Outcomes

After the intensive three-week intervention, the patient demonstrated profound functional and neurological recovery. The post-assessment revealed the resolution of the cranial nerve deficits: the right ptosis and left UMN facial palsy were no longer present. Sensory examination, which initially noted hypoesthesia and impaired proprioception on the left, was entirely intact on post-assessment across all modalities. Spasticity on the left decreased significantly to MAS Grade 1+. MMT showed marked improvement, with the left upper limb reaching 3/5 and the left lower limb reaching 2/5 (hip) and 3/5 (knee/ankle). VCG was hip grade 2, knee grade 3 and ankle grade 3. Functional outcome measures improved substantially: MOCA increased from 18/30 to 24/30; BBS improved from 17/56 to 33/56, transitioning the patient from wheelchair dependence to walking with assistance; FIM improved from 39/126 (Severe dependence) to 70/126 (Moderate dependence); and TUG improved from 30s to 23s. House-Brackmann grading improved from IV to II.

Discussion

The successful, rapid neurological and functional gains observed in this patient underscore the critical role of timely and targeted physiotherapy, even in the context of a devastating and complex condition like Moya Moya Disease-related stroke. MMD introduces a unique challenge: the underlying chronic hypoperfusion may compromise the structural integrity required for optimal neuroplasticity [7]. Therefore, a rehabilitation approach that maximizes cortical and subcortical engagement is paramount.

The necessity for physiotherapy in this case was dictated by the severe UMN signs. The initial deficits, including the co-occurrence of bilateral motor weakness (MMT 3/5 on the right) and cranial nerve palsies, suggested a diffuse or multifocal vascular insult, common in MMD, requiring a broad, integrative rehabilitation strategy.

Our protocol was heavily focused on principles of motor learning and neuroplasticity, with Mirror Therapy serving as a key intervention for the severely paretic left side. Mirror therapy provides visual feedback to the brain, which is believed to activate the motor and pre-motor cortices of the affected hemisphere via the non-affected side, promoting motor reorganization and reducing learned non-use [8]. The inclusion of functional task training alongside constraint-induced movement therapy principles ensured the patient's emerging motor control was immediately translated into meaningful, task-specific actions [9]. Furthermore, dedicated stretching and positioning were crucial in mitigating the MAS Grade 3 spasticity and preventing secondary complications, leading to the

observed favourable reduction to Grade 1+.

The quantitative results validate the protocol's effectiveness. The increase in the BBS score is particularly compelling, representing a transition from a state of total mobility dependence to one where community ambulation, albeit assisted, becomes a realistic goal. Similarly, the jump from severe to moderate dependence on the FIM indicates a significant burden reduction for caregivers and an improved quality of life for the patient [10]. The improvement in the MOCA score suggests that the intensive, engaging, and cognitively demanding nature of the therapy also positively influenced executive function and attention, which are often co-impaired following cerebral insult.

Most remarkably, the complete resolution of the sensory deficit and cranial nerve palsies post-intervention highlights the brain's potential for recovery through spontaneous plasticity, which may be facilitated by early, aggressive rehabilitation. This case report contributes to the literature by providing detailed outcome measures, specifically demonstrating that a targeted, plasticity-driven protocol can yield substantial functional recovery in patients with MMD, challenging any nihilistic views associated with this severe diagnosis. Future studies should explore the long-term efficacy and optimal intensity of Mirror Therapy combined with functional training in this patient population.

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