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Efficacy of Physiotherapy in Moya Moya Disease: A Case Report

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ABSTRACT

Moyamoya disease (MMD) is a rare, progressive cerebrovascular disorder involving stenosis of the internal carotid arteries and collateral vessel formation, increasing the risk of paediatric ischemic and haemorrhagic strokes. Affected children often exhibit hemiplegia, balance issues, and gait abnormalities, necessitating early physiotherapy rehabilitation. This case study evaluated a 12-week physiotherapy program aimed at improving motor function, balance, and independence in a six-year-old girl with MMD and left-sided hemiplegia.The study followed a single-case therapeutic intervention design. Following baseline assessments, the child underwent a structured 12-week physiotherapy program consisting of electrical stimulation, motor re-education, task-oriented balance training, lower-limb strengthening, and gait training. Outcome measures included the Gross Motor Function Measure (GMFM), Pediatric Balance Scale (PBS), and Modified Ashworth Scale (MAS). Pre- and post-intervention scores were compared to evaluate functional gains and changes in muscle tone. Post-intervention results demonstrated substantial improvement across all domains. GMFM scores increased from 56% to 90%, indicating marked enhancement in gross motor abilities. The PBS score improved from 8/56 to 52/56, reflecting significant gains in postural control and balance. A reduction in MAS grades was observed, suggesting decreased spasticity in the affected extremities. The child demonstrated noticeable improvements in gait stability, day-to-day participation, and independence in mobility activities. This case study highlights the positive impact of a comprehensive, individualized physiotherapy program on motor performance and independence in a child with Moyamoya disease. Early, targeted rehabilitation can play a crucial role in optimizing functional outcomes in paediatric MMD, underscoring the need for sustained therapeutic intervention.

1. INTRODUCTION

The distal intracranial internal carotid arteries and adjacent vessels in the circle of Willis gradually constrict or become blocked in Moyamoya disease (MMD), a rare, chronic cerebrovascular condition of unclear etiology. The brain creates a delicate network of collateral capillaries at its base to make up for the decline in blood flow through these major arteries. The term "moyamoya" comes from the unique appearance these delicate arteries provide on angiography, which resembles a puff of smoke[1]This, progressive stenosis of major intracranial arteries in Moyamoya disease results in diminished cerebral perfusion. In response to this reduction in blood flow, a network of delicate collateral vessels develops as a compensatory mechanism to restore cerebral circulation [2].The designation "Moyamoya" originates from the Japanese language, signifying "hazy," "swollen," or "foggy" [2].The development of these vessels, along with the stenosis of the circle of Willis arteries, are key angiographic features of the disease [3].

Globally, MMD prevalence and occurrence varies, with the greatest rates reported in Korea, Japan, and China [4].Epidemiological research in Japan has reported that the prevalence of Moyamoya disease varies between 3.2 and 10.5 cases per 100,000 individuals, with the condition occurring more frequently in females [4]. A 2004 follow-up study noted an increase in diagnoses

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compared to 2003, which documented a rate of of 0.54 per 100,000 individuals[5].Similarly, a research carried out at Hokkaido between 2002 and 2006 reported an incidence of 0.94 and a prevalence of 10.5 per 100,000 based on 267 new cases [5].However, the incidence and prevalence in India remain undetermined due to limited data [6].

Moyamoya syndrome (MMS) is related to Moyamoya angiopathy and may occur with various neurological or systemic manifestations, either with or without a clear genetic or acquired cause. However, the precise cause is still not known, There is thought to be a genetic foundation for MMD, with mutations in genes related to vascular development implicated in its pathogenesis. Environmental and autoimmune factors may also play a role [7].

Diagnostic advancements in imaging have improved early detection, while surgical revascularization has enhanced outcomes [8].In children, common presentations include infantile hemiplegia, strokes, and transient ischemic attacks. Around 80.5% of pediatric patients exhibit motor disorders, headaches, and choreiform movements, with 9% experiencing convulsions [9].

Despite this, research on physical rehabilitation is limited. Most studies focus on surgical interventions, neglecting physical therapy especially in children. This case study emphasizes the need for tailored rehabilitation strategies to improve outcomes in pediatric patients with MMD [10].

2. MATERIALS AND METHODS

This study adhered with all ethical standards and received approval from the Krishna Vishwa Vidyapeeth Deemed-to-be University, Karad, under reference number [KVV/IEC/04/2025]. Informed consent was obtained from the participant using a volunteer consent form that clearly outlined the purpose of the research, potential risks and benefits, confidentiality provisions, and participants' rights. The study was conducted with ethical principles of the Declaration of Helsinki, ensuring that participant rights, safety, and well being were prioritized throughout the study's design, procedures, and confidentiality measures.

2.1. Case Presentation

A 6 year old girl was admitted to the hospital after developing a facial abnormality since three days, accompanied by weakness in the left upper and lower extremities. These symptoms were preceded by multiple episodes of vomiting, and her guardian also reported high-grade fever and headache. Upon admission, routine laboratory tests were performed, all of which returned within normal limits. The patient was managed conservatively with intravenous fluids, low molecular weight heparin, a platelet aggregation inhibitor, and IV antibiotics for five days to address the fever and related symptoms.

Her past medical history included a tonic seizure with similar facial deviation approximately one year prior. Family history revealed a sister diagnosed with epilepsy. Magnetic resonance imaging identified an acute, non-hemorrhagic infarct localized to the right middle cerebral artery territory. Further neurodiagnostic studies supported the Moyamoya illness diagnosis.

During her inpatient stay, the patient was referred to the physiotherapy department due to persistent weakness and complete loss of motor function in the left limbs, as well as facial asymmetry caused by the rightward deviation of the mouth. Following a 21-day hospitalization, she was discharged and enrolled in a structured physiotherapy rehabilitation program, which continued for 12 weeks post-discharge, aiming to restore motor function and improve overall quality of life.

Furthermore, numerous small collateral vessels were identified within the bilateral Sylvian fissures and capsuloganglionic regions, accompanied by dilated and tortuous vessels in the posterior pericallosal area, consistent with the characteristic hazy vascular network commonly seen in Moyamoya disease.

This study included the Pediatric Balance Scale (PBS), Gross Motor Function Measure (GMFM), and the Modified Ashworth Scale (MAS).

2.2 Physiotherapy Intervention Programme

A 12-week physiotherapy protocol was formulated as outlined in Table 1.

3. RESULTS

Table 2 Summarises the pre- and post-intervention values of PBS, GMFM, (MAS). The participant showed improvement in PBS scores, indicating better balance performance. GMFM scores also increased, reflecting enhanced gross motor functional abilities. A reduction in MAS grade was noted post-intervention, demonstrating decreased spasticity following therapy. The results are summarized in the subsequent graphical representations, illustrating improvements in Balance and Gross motor function, which demonstrated significant improvement following the course of treatment in Fig 1 and Fig 2

Table1. Structured physiotherapy ınterventıon

Time Frame	Rehabilitation Component	Description of Intervention
0–8 Weeks	Passive Range of Motion (PROM)	PROM exercises for left upper and lower limbs; 10 repetitions per joint, 3 sets
	PNF Stretching	D1 and D2 patterns applied to left upper and lower limbs
	Electrical Stimulation – Face	Right side of face: Galvanic stimulation for motor points; Faradic current for trunk muscles
	Electrical Stimulation – Upper Limb	Faradic current applied to group muscles of the left forearm extensors
	Joint Compression	Left upper limb in sitting and quadruped positions; 30 seconds hold, 3 sets
	Facial Exercises with Biofeedback	Mirror-assisted facial movements: smiling, blinking, eyebrow raising, and cheek puffing
8–12 Weeks	Coordination Training	Ball catching (half-kneeling), reach-outs (sitting and standing), pegboard activities, and block-building games
	Balance Training	Parallel bar walking and side walking; initiated at 2 minutes, gradually increased to 8 minutes
	Balance Training	Obstacle and slope walking; initiated at 2 minutes, progressed to 6–8 minutes
	Strengthening exercises for Lower limb	Wall squats (15-second hold, 3 sets), dynamic quadriceps exercises, lunges (10 repetitions, 2–3 sets)
	Strengthening exercises for Upper limb	Thera-band-assisted shoulder flexion, abduction, extension, and elbow flexion/extension; 5–6 repetitions, 3-second hold

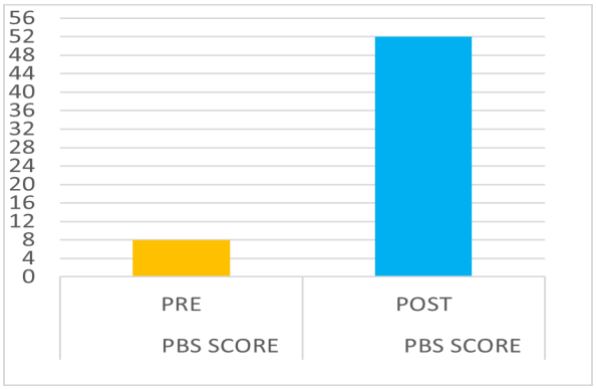

Fig 1. Pediatric balance score

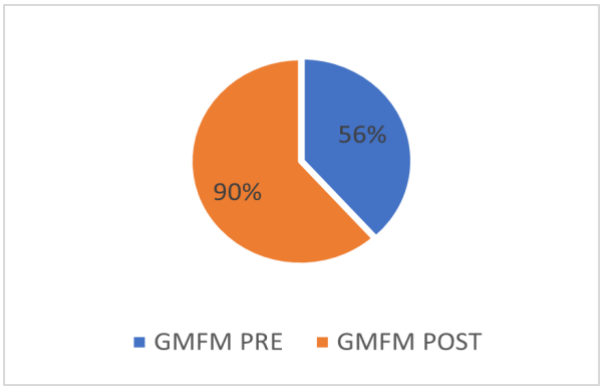

Fig 2. Gross Motor function Measures

Table 2. Pre- and Post-intervention scores of PBS, GMFM and MAS

Outcome measure	Pre-score	Post-score
Pediatric Balance Scale (PBS)	8/56	52/56
Gross Motor Function Measures (GMFM)	56%	90%
Modified Ashworth Scale (MAS)	Grade III in left UL Grade III in left LL	Grade II in leftUL grade I+ in left LL

4. DISCUSSION

The effectiveness of a structured physiotherapy protocol was evaluated in a pediatric patient diagnosed with Moyamoya disease, focusing on improvements in balance, muscle tone, and gross motor function. The patient underwent a 12-week individualized rehabilitation protocol, which led to substantial improvements across all targeted domains. Standardized assessment tools including MAS, GMFM-88, PBS were applied to measure outcomes. Initial assessments revealed deficits in all areas, which significantly improved post-intervention These findings align with those reported in earlier research, particularly the work by Sanjay Parmar et al. [11], which demonstrated that structured physiotherapy enhances motor function, reduces musculoskeletal complications, and increases independence in daily activities. Multisystem stimulation integrating sensory-motor, cognitive, and visual input has been shown to facilitate cross-modal neuroplasticity and

improve functional outcomes in patients with ischemic injuries. Wagle IA et al. [6], also emphasized the value
of repetitive, task-oriented training directed at preserved brain regions to strengthen synaptic connections and support motor recovery. In paediatric populations, such interventions have improved gait and endurance, while adult programs showed a 66% reduction in pain and functional improvements. Damayanti Sethy et al. [12], stressed the importance of early, intensive rehabilitation in slowing progressive motor decline in Moyamoya disease. Our findings align with these observations, showing more prominent functional gains in the later stages of therapy. Though literature remains limited, existing evidence highlights the essential role of maintenance physiotherapy in sustaining recovery and fostering independence in paediatric Moyamoya cases.

5. Conclusion

This case emphasizes the efficacy of early, structured physiotherapy in paediatric Moyamoya disease, demonstrating notable improvements in motor function and independence. It reinforces physiotherapy's essential role in promoting neuroplastic recovery within a comprehensive, multidisciplinary framework for optimal results.

Conflict of Interest

No conflict of interest is declared by tehe authors. In addition, no financial support was received.

Ethics Committee

This study adhered with all ethical standards and received approval from the Krishna Vishwa Vidyapeeth Deemed-to-be University, Karad, under reference number [KVV/IEC/04/2025].

Author Contributions

Study Design, MRAB and MM; Data Collection, MRAB and DK; Statistical Analysis, MRAB; Data Interpretation, MM and DK; Manuscript Preparation, MRAB, MM and DK; Literature Search, MRAB, MM and DK. All authors have read and agreed to the published version of the manuscript.

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