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Effect of Neurodevelopmental Treatment and Myofascial Release in Spastic Quadriplegic Cerebral Palsy: A Case Report

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Abstract

Background: Spastic quadriplegic cerebral palsy (CP) is a severe subtype characterized by generalized spasticity and significant motor developmental delay. Physiotherapy interventions such as Neurodevelopmental Treatment (NDT) and Myofascial Release (MFR) are commonly used; however, evidence regarding their combined effects remains limited.

Objective: To evaluate the effects of combined NDT and MFR on spasticity, neurological function, and gross motor ability in a child with spastic quadriplegic CP.

Methods: This study employed a single-case report design. A 1-year-old male with a history of prematurity (32 weeks gestation), low birth weight (1.5 kg), and prior Pediatric Intensive Care Unit admission presented with severe motor delay and generalized spasticity. The intervention consisted of NDT and MFR administered twice weekly for four weeks. Outcomes were assessed using the Modified Ashworth Scale (MAS), Gross Motor Function Classification System (GMFCS), and Hammersmith Infant Neurological Examination (HINE). Data were analyzed descriptively using longitudinal comparison.

Results: Spasticity at the knee decreased from MAS 1+ to 1, indicating reduced resistance to passive movement. Neurological function improved, with HINE increasing from 34 to 39. However, no change was observed in gross motor function, as GMFCS remained at level V. These findings indicate clinically meaningful improvements in muscle tone and neurological status, despite unchanged functional mobility.

Conclusion: Combined NDT and MFR may improve spasticity and neurological function in severe CP, although gross motor improvements require longer-term intervention.

Keywords

cerebral palsy, spastic quadriplegia, neurodevelopmental treatment, myofascial release, muscle spasticity, neurological examination

Introduction

Cerebral palsy (CP) is a non-progressive neurodevelopmental disorder resulting from injury to the developing brain, leading to permanent impairments in movement, posture, and motor coordination.[1] These motor impairments are frequently accompanied by spasticity, muscle weakness, sensory dysfunction, and delayed motor development, all of which contribute to significant limitations in functional independence and reduced quality of life.[1,2]

Globally, CP remains one of the most common causes of childhood physical disability, with prevalence estimates ranging from 0.6 to 0.7 per 1,000 live births.[3,4] However, variations in diagnostic criteria, surveillance systems, and population characteristics contribute to inconsistencies in epidemiological data.[4] Despite these variations, CP continues to pose a substantial clinical and public health burden, particularly in low- and middle-income countries where access to early rehabilitation services may be limited.[5]

Based on the distribution of motor impairment, CP is classified into several subtypes, among which spastic quadriplegia represents one of the most severe forms.[6] This subtype is characterized by involvement of all four extremities, marked hypertonia, impaired postural control, and severely restricted voluntary movement.[7] Children with spastic quadriplegia commonly present with profound delays in motor milestones, including difficulties in head control, rolling, sitting, and performing functional activities.[8] These limitations are often associated with long-term dependence in daily activities and increased caregiver burden.

Physiotherapy plays a fundamental role in the management of CP, aiming to reduce spasticity, improve motor control, and enhance functional abilities.[9] Among the commonly applied approaches, Neurodevelopmental Treatment (NDT) focuses on facilitating normal movement patterns and inhibiting abnormal reflex activity through guided handling and sensorimotor stimulation.[10] In contrast, Myofascial Release (MFR) targets restrictions within the fascial system to improve tissue extensibility, reduce muscle stiffness, and enhance range of motion.[11] Both interventions are widely used in clinical practice; however, their mechanisms of action differ and may provide complementary therapeutic effects.

Despite the widespread application of NDT and MFR, current evidence predominantly evaluates these interventions in isolation, and limited studies have explored their combined effects, particularly in children with severe forms of CP such as spastic quadriplegia.[12] Furthermore, the short-term impact of combined physiotherapy interventions on both neurological function and spasticity remains insufficiently documented in single-case clinical contexts.

Therefore, this case report aims to evaluate the clinical effects of combined Neurodevelopmental Treatment and Myofascial Release on spasticity, neurological function, and gross motor ability in a child with spastic quadriplegic cerebral palsy presenting with severe motor developmental delay.

Methods

This study was conducted as a single-case report in accordance with the CARE (CAse REport) guidelines to provide a comprehensive description of clinical findings, intervention, and outcomes in a child with spastic quadriplegic cerebral palsy. A 1-

year-old male was referred to the physiotherapy outpatient clinic with complaints of delayed motor development. The patient was unable to achieve age-appropriate milestones, including rolling, crawling, and independent sitting. The child was born prematurely at 32 weeks of gestation via cesarean section, with a birth weight of 1.5 kg. He had a history of admission to the Pediatric Intensive Care Unit following birth. No history of trauma, prenatal bleeding, or hereditary neurological disorders was reported. Anthropometric assessment revealed a body length of 68 cm and a body weight of 6.4 kg.

Clinical examination demonstrated severe motor impairment. The patient exhibited poor head control, kyphotic posture in supported sitting, and persistent hand grasping. Palpation indicated generalized hypertonia in both upper and lower extremities. Active movement was limited in all extremities, whereas passive range of motion was preserved. Developmental assessment indicated that the child was unable to perform prone positioning, rolling, crawling, or independent sitting, consistent with severe motor developmental delay. A structured timeline of the clinical course and intervention is presented in Table 1.

Table 1. Clinical Timeline

Time Point	Clinical Events
Week 0 (T1)	Baseline assessment (MAS, GMFCS, HINE)
Week 1–2 (T2)	Ongoing intervention and mid-evaluation (MAS, HINE)
Week 3–4	Continued intervention
Week 4 (T3)	Final evaluation (MAS, HINE, GMFCS)

Clinical evaluation was performed using standardized instruments. The Modified Ashworth Scale (MAS) was used to assess muscle spasticity based on resistance to passive movement, with scores ranging from 0 to 4 and an additional grade of 1+ indicating slight increase in muscle tone. The Gross Motor Function Classification System (GMFCS) was used to classify functional motor ability into five levels, with level V indicating severe limitation in head and trunk control and complete dependence for mobility.

The Hammersmith Infant Neurological Examination (HINE) was used to evaluate neurological function, including cranial nerve function, posture, tone, reflexes, and movement. A HINE score below 40 at this age is generally associated with a high risk of neurological impairment and adverse motor outcomes. Differential diagnoses, including neuromuscular disorders and genetic syndromes, were considered less likely based on the clinical presentation, absence of progressive symptoms, and history of prematurity, which is a known risk factor for cerebral palsy. Baseline findings are summarized in Table 2.

Table 2. Baseline Assessment

Parameter	Result
MAS	1–1+ (mild spasticity)
GMFCS	Level V
HINE	34

The diagnosis of spastic quadriplegic cerebral palsy was established based on clinical findings, including generalized hypertonia, delayed motor development, and a history of prematurity. The physiotherapy intervention consisted of a combination of Neurodevelopmental Treatment (NDT) and Myofascial Release (MFR), administered over a 4-week period. NDT was applied using structured handling techniques aimed at facilitating normal movement patterns, improving postural control, and inhibiting abnormal reflex activity. The intervention focused on trunk alignment, head control facilitation, and proximal stability through sensorimotor stimulation. MFR was applied to major muscle groups in both upper and lower extremities, including wrist flexors, elbow flexors, hip adductors, hamstrings, and gastrocnemius. The technique involved sustained gentle pressure and stretching to reduce fascial restriction and muscle stiffness. The selected frequency and duration of intervention were based on previous studies suggesting that repeated sensorimotor stimulation and soft tissue mobilization are required to achieve measurable changes in muscle tone and neuromotor function in children with cerebral palsy. The intervention protocol is presented in Table 3.

Table 3. Intervention Protocol

Component	Frequency	Duration	Description
NDT	2 sessions/week	60 minutes/session	Facilitation, inhibition, postural control
MFR	2 sessions/week	Included in session	5 minutes per muscle group

Progression of therapy was adjusted based on patient tolerance and response to intervention. Outcome measures included MAS, HINE, and GMFCS, assessed at baseline (T1), mid-intervention (T2), and post-intervention (T3). These measures were used to evaluate changes in spasticity, neurological function, and gross motor ability over time. No adverse events were observed during the intervention period. Data were analyzed descriptively using longitudinal comparison across three time points (T1, T2, and T3). Changes were interpreted based on absolute differences and clinical relevance. Written informed consent was obtained from the patient's parents prior to participation. Formal ethical approval was not required for this case report in accordance with institutional policy, as no experimental intervention was conducted and patient anonymity was maintained.

Results

Outcome measurements were conducted at three time points: baseline (T1), mid-intervention (T2), and post-intervention (T3) to evaluate changes in spasticity, neurological function, and gross motor classification following the 4-week intervention. The longitudinal assessment of muscle spasticity using the Modified Ashworth Scale (MAS) is presented in Table 4.

Table 4. Longitudinal Spasticity Assessment (MAS)

Joint	T1 (Right)	T1 (Left)	T2 (Right)	T2 (Left)	T3 (Right)	T3 (Left)
Shoulder	1	1	1	1	1	1
Elbow	1	1	1	1	1	1
Wrist	1+	1+	1+	1+	1+	1+
Hip	1	1	1	1	1	1
Knee	1+	1+	1+	1+	1	1
Ankle	1	1	1	1	1	1

The findings demonstrate a reduction in spasticity at the knee joint bilaterally, where MAS scores decreased from 1+ at baseline (T1) to 1 at post-intervention (T3). No changes were observed in other joints throughout the intervention period. Neurological function was evaluated using the Hammersmith Infant Neurological Examination (HINE), as summarized in Table 5.

Table 5. Longitudinal Neurological Assessment (HINE)

Component	T1	T2	T3
Cranial Nerve Function	6	7	7
Movement	3	3	3
Posture	11	11	11
Tone	10	12	12
Reflexes and Reactions	4	6	6
Total Score	34	39	39

The total HINE score increased from 34 at baseline (T1) to 39 at mid-intervention (T2) and remained stable at 39 at post-intervention (T3). Improvements were observed in cranial nerve function, tone, and reflex components, while movement and posture scores remained unchanged. Gross motor function classification based on the Gross Motor Function Classification System (GMFCS) remained at level V across all time points, indicating no observable change in functional motor classification during the intervention period. GMFCS classification remained stable at level V across all evaluation time points (T1–T3), indicating no observable change in gross motor classification during the intervention period. No adverse events or complications were reported throughout the intervention.

To further illustrate the longitudinal changes observed during the intervention period, graphical representations of neurological function and muscle spasticity are presented below. These figures provide a visual overview of trends in Hammersmith Infant Neurological Examination (HINE) scores and knee joint spasticity measured using the Modified Ashworth Scale (MAS) across the three evaluation time points (T1–T3).

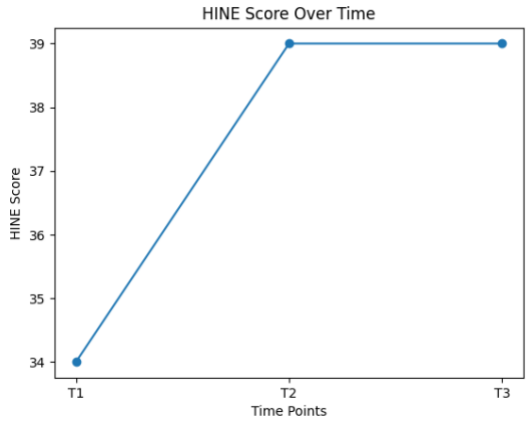

Figure 1. Longitudinal Changes in HINE Score (T1–T3)

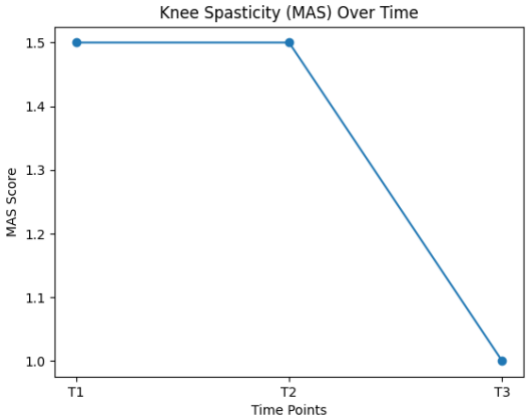

Figure 2. Change in Knee Spasticity (MAS) Over Time

Discussion

This case report demonstrates that a 4-week physiotherapy intervention combining Neurodevelopmental Treatment (NDT) and Myofascial Release (MFR) was associated with reductions in muscle spasticity and improvements in neurological function, although no change was observed in gross motor classification. These findings highlight the differential responsiveness of neuromuscular components to short-term intervention in children with severe spastic quadriplegic cerebral palsy.

The reduction in spasticity observed at the knee joint, as indicated by a decrease in Modified Ashworth Scale (MAS) score from 1+ to 1, may be explained by the combined effects of neuromodulation and soft tissue adaptation. NDT is designed to inhibit abnormal reflex activity and facilitate more normalized movement patterns through sensorimotor input and postural control strategies.[13] This approach likely contributes to decreased excitability of stretch reflexes and improved motor control. In parallel, MFR may enhance tissue extensibility by reducing fascial restrictions and altering the viscoelastic properties of muscle and connective tissue.[14] The combination of these mechanisms may explain the localized reduction in spasticity observed in this case.

The improvement in neurological function, reflected by an increase in Hammersmith Infant Neurological Examination (HINE) score from 34 to 39, further supports the role of sensorimotor-based interventions in promoting neurodevelopment. HINE is recognized as a sensitive tool for detecting changes in neurological status in high-risk infants and monitoring developmental progress

over time.[15] The observed improvements in cranial nerve function, muscle tone, and reflex responses suggest enhanced integration of neural pathways and improved central nervous system responsiveness following repeated therapeutic stimulation.[16]

Importantly, the changes in MAS and HINE appear to be interrelated. Reduction in muscle tone may facilitate improved voluntary movement and postural control, which in turn contributes to better neurological performance.[17] Conversely, enhanced neurological function may reflect improved motor unit recruitment and coordination, indirectly influencing muscle tone. This bidirectional relationship underscores the importance of addressing both neural and musculoskeletal components in the rehabilitation of children with CP.[18]

Despite these improvements, no change was observed in the Gross Motor Function Classification System (GMFCS), which remained at level V throughout the intervention period. This finding is consistent with previous evidence indicating that GMFCS levels are relatively stable over time and are not expected to change significantly within short intervention periods.[19,20] GMFCS reflects broad functional abilities rather than subtle clinical improvements, and changes in classification typically require longer durations of intervention and developmental progression.[20] Therefore, the absence of change in GMFCS in this case does not necessarily indicate a lack of therapeutic benefit but rather reflects the severity of impairment and the limited timeframe of intervention.

The duration and intensity of intervention are important factors influencing clinical outcomes. A 4-week intervention period, although sufficient to produce measurable changes in spasticity and neurological function, may not be adequate to induce observable changes in gross motor abilities. Previous studies have suggested that long-term, intensive, and task-specific training is required to achieve meaningful improvements in functional mobility in children with CP.[20] These findings emphasize the need for sustained and progressive rehabilitation programs.

From a clinical perspective, these findings suggest that early implementation of combined NDT and MFR may be beneficial in reducing spasticity and enhancing neurological responsiveness in children with severe CP. This approach may assist physiotherapists in designing individualized, multimodal intervention programs targeting both neural and musculoskeletal components.

However, several limitations should be acknowledged. First, this study involved a single subject, which limits the generalizability of the findings. Second, the short duration of intervention restricts the ability to evaluate long-term outcomes, particularly in relation to functional motor development. Third, the absence of objective biomechanical or neurophysiological measurements may limit the precision of outcome interpretation.

Despite these limitations, this case report provides valuable clinical insight into the short-term effects of combined physiotherapy interventions in severe CP and highlights the importance of early, multimodal rehabilitation strategies.
Short-term combined NDT and MFR interventions may improve spasticity and neurological function; however, meaningful changes in gross motor ability require prolonged and sustained therapy.

Conclusion

This case report demonstrates that a 4-week physiotherapy intervention combining Neurodevelopmental Treatment (NDT) and Myofascial Release (MFR) was associated with reduced spasticity and improved neurological function in a child with spastic quadriplegic cerebral palsy. Specifically, a decrease in muscle tone at the knee joint and an increase in Hammersmith Infant Neurological Examination (HINE) score indicate clinically meaningful neuromotor improvements following short-term intervention.

However, no change was observed in gross motor function as classified by the Gross Motor Function Classification System (GMFCS), which remained at level V. This finding suggests that improvements in gross motor ability require longer duration, higher intensity, and sustained rehabilitation programs. From a clinical perspective, the combination of NDT and MFR may provide complementary benefits by addressing both neural and musculoskeletal components of impairment. Early implementation of such multimodal interventions may support neuromotor development, although long-term follow-up is essential to achieve functional gains. Clinically, physiotherapists should consider combining neurodevelopmental and myofascial approaches as part of early intervention strategies, while recognizing that improvements in gross motor function require long-term and consistent therapy.

Author Contribution

Indy Viorohma Asinta Zahra: Conceptualization, data collection, intervention implementation, and manuscript drafting.
Agus Widodo: Supervision, methodology development, and manuscript review and editing.
Ika Hayati: Data analysis, interpretation of findings, and manuscript proofreading.

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Conflict of Interest Statement

The authors declare no conflict of interest.

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Ethics Statement

This study was conducted in accordance with institutional ethical standards. Written informed consent was obtained from the patient's parents prior to participation.

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