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Tailored Physiotherapy Management of Motor Neuron Disease with Predominant Lower Motor Neuron Involvement in a Young Adult: A Case Report

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Case Report

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Abstract

Background:

Motor neuron disease (MND) is a progressive neurodegenerative disorder involving degeneration of upper and/or lower motor neurons, resulting in muscle weakness and functional decline. Progressive muscular atrophy (PMA) represents a lower motor neuron–predominant phenotype within the MND spectrum and commonly presents with distal limb weakness and progressive disability.

Objective:

To describe the clinical, electrophysiological, and functional outcomes of a young adult with lower motor neuron–predominant motor neuron disease managed with tailored physiotherapy rehabilitation.

Methods and Materials:

A middle aged male with progressive bilateral lower limb weakness for one year and tingling sensations for six months was evaluated clinically and electrophysiologically. He had a prior history of lumbar laminectomy following a road traffic accident and was a known case of MND. Assessment included neurological examination and electromyography, which demonstrated a neurogenic pattern consistent with predominant lower motor neuron involvement. A structured, goal-oriented physiotherapy program focusing on strength maintenance, balance training, gait re-education, and functional mobility was implemented.

Results:

Post-rehabilitation assessment revealed improvement in balance, ambulation, functional independence, and activities of daily living, with stabilization of muscle strength and improved gait safety.

Conclusion:

Early diagnosis and individualized physiotherapy intervention play a crucial role in preserving functional abilities and improving quality of life in patients with lower motor neuron–predominant motor neuron disease.

Key Message

Early diagnosis and tailored physiotherapy are essential to preserve function and improve quality of life in motor neuron disease.

INTRODUCTION

Motor neuron diseases (MNDs) constitute a heterogeneous group of progressive neurodegenerative disorders characterized by selective involvement of upper motor neurons (UMNs), lower motor neurons (LMNs), or both, resulting in muscle weakness, atrophy, spasticity, and subsequent functional impairment. Amyotrophic lateral sclerosis is the most common form, accounting for approximately 80–85% of cases, followed by primary lateral sclerosis, progressive muscular atrophy, and progressive bulbar palsy (1). The global prevalence of MND is estimated at 1–2 per 100,000 population annually, with a higher incidence in males and a typical onset between the fifth and seventh decades of life .Pathologically, MND involves degeneration of motor neurons in the motor cortex, brainstem nuclei, and anterior horn cells of the spinal cord, leading to combined UMN and LMN manifestations (2). Clinically, patients present with progressive limb weakness, muscle wasting, fasciculations, spasticity, impaired fine motor control, and, in advanced stages, bulbar and respiratory involvement, which significantly affect prognosis and quality of life (3). Although the exact etiology remains unclear, proposed mechanisms include glutamate excitotoxicity, oxidative stress, mitochondrial dysfunction, abnormal protein aggregation, and genetic mutations such as SOD1 and C9orf72 (4) Electrodiagnostic studies, particularly electromyography, are crucial for detecting LMN involvement through neurogenic patterns of chronic denervation and reinnervation, while nerve conduction studies help exclude peripheral neuropathies (5) (6). Early diagnosis facilitates timely multidisciplinary management, including physiotherapy, which plays a vital role in preserving function, reducing complications, and improving quality of life using standardized outcome measures.(7).(8)This case report aims to present a detailed clinical, electrophysiological, and physiotherapeutic profile of a patient diagnosed with motor neuron disease demonstrating a neurogenic pattern on EMG, highlighting the role of electrodiagnostic evaluation in diagnosis and the impact of structured physiotherapy intervention on functional outcomes.(9) The report also emphasizes the relevance of appropriate outcome measures in tracking disease progression and rehabilitation efficacy.(7)

CASE REPORT

A middle aged male presented with progressive bilateral lower limb weakness for one year, initially causing difficulty in walking long distances and climbing stairs, later requiring a walking stick for ambulation. He also reported tingling pain in both lower limbs without bowel, bladder, bulbar, respiratory, visual, or cognitive involvement. He had a history of lumbar laminectomy following a road traffic accident 18 years earlier and was diagnosed with motor neuron disease two years prior. There was no family history of neuromuscular disorders.

Examination revealed hypotonia, distal-predominant weakness (MRC 4/5), fasciculations, and reduced deep tendon reflexes in both lower limbs, with preserved upper limb function. Gait was unsteady with poor balance. MRI showed postoperative changes without spinal cord compression. Nerve conduction studies and electromyography demonstrated selective motor involvement with chronic denervation, consistent with lower motor neuron–predominant motor neuron disease (progressive muscular atrophy

phenotype). A multidisciplinary approach with tailored physiotherapy was initiated to preserve functional mobility and quality of life.

A goal-oriented physiotherapy intervention plan is detailed in Table 1.

Physiotherapy Management :

Table 1
goal-oriented physiotherapy intervention.

Sr.no	Problem Identified	Physiotherapy Goals	Intervention Strategies	Dosage & Frequency	Clinical Rationale
1.	Progressive lower limb weakness	Maintain existing muscle strength and delay functional decline	Low-intensity active and active-assisted strengthening exercises for lower limb muscles	8–10 repetitions, 1–2 sets, once daily	Submaximal strengthening helps preserve muscle function without inducing excessive fatigue in MND
2.	Muscle hypotonia and wasting	Prevent further disuse atrophy	Functional task-based exercises and gravity-minimized movements	Daily practice during therapy sessions	Functional activities promote neuromuscular activation and muscle engagement
3.	Reduced endurance and early fatigue	Improve activity tolerance	Low-intensity endurance training such as slow walking with rest intervals	5–10 minutes with rest breaks, once daily	Energy-conserving aerobic activity improves endurance without overexertion
4.	Impaired balance and postural control	Improve balance and reduce fall risk	Static and dynamic balance training in sitting and standing	10–15 minutes per session	Balance training enhances postural stability and gait safety
5.	Gait instability	Improve safe ambulation	Gait training with walking stick and therapist supervision	Daily gait practice	Assistive devices reduce energy cost and improve walking safety
6.	Difficulty in transfers and mobility	Promote functional independence	Bed mobility and transfer training (sit-to-stand, chair transfers)	Repeated functional practice	Task-specific training improves independence in daily activities
7.	Risk of secondary musculoskeletal complications	Prevent joint stiffness and pain	Active range-of-motion exercises for all major joints	10 repetitions per joint, once daily	Maintains joint mobility and prevents contractures
8.	Sensory discomfort (tingling)	Improve sensory awareness and comfort	Sensory re-education techniques and tactile stimulation	As tolerated	Enhances sensory input and patient comfort

Sr.no	Problem Identified	Physiotherapy Goals	Intervention Strategies	Dosage & Frequency	Clinical Rationale
9.	Fatigue during daily activities	Teach energy conservation	Education on pacing, rest periods, and activity modification	Ongoing education	Reduces fatigue and promotes long-term adherence
10.	Need for long-term management	Encourage self-management	Home exercise program and caregiver education	Daily home program	Ensures continuity of care and long-term functional maintenance

The physiotherapy intervention included therapeutic exercises such as pelvic bridging to improve trunk control and lower limb strength, as illustrated in Fig. 1.

Changes in outcome measures before and after rehabilitation are presented in Table 2.

Outcome Measures and follow -up :

Table 2
outcome measures

Sr. No.	Scales	Domain Assessed	Pre-Rehabilitation	Post-Rehabilitation
1.	Manual Muscle Testing (MMT) – Lower Limbs	Muscle strength	3/5 bilaterally	4/5 bilaterally
2.	Berg Balance Scale (BBS)	Static and dynamic balance	18/56	32/56
3.	Functional Independence Measure (FIM)	Functional independence	65/126	90/126
4.	Modified Rankin Scale (mRS)	Degree of disability	Grade 4	Grade 3
5.	Functional Ambulation Category (FAC)	Ambulation ability	Level 1	Level 3
6.	Barthel Index	Activities of Daily Living (ADLs)	40/100	70/100

DISCUSSION

Motor neuron disease (MND) is a progressive neurodegenerative disorder affecting motor neurons in the brain and spinal cord, leading to combined or isolated upper and lower motor neuron involvement. Among its clinical subtypes, progressive muscular atrophy (PMA) represents a predominantly lower motor neuron (LMN) phenotype, characterized by muscle weakness, wasting, hypotonia, fasciculations,

and diminished reflexes without significant upper motor neuron signs (8). PMA accounts for approximately 5–10% of all MND cases and often presents with distal limb onset, particularly affecting the lower limbs .The current case demonstrated classical LMN-predominant features: progressive bilateral lower limb weakness over one year, hypotonia, fasciculations, and reduced deep tendon reflexes. Sensory involvement was minimal, consistent with the motor neuron–specific pathology, with mild tingling sensations likely secondary to chronic motor unit loss rather than primary sensory nerve involvement.(2, 10)

Electrodiagnostic studies are integral for differentiating MND subtypes and ruling out mimics such as peripheral neuropathy, radiculopathy, or post-surgical deficits. In this patient, nerve conduction studies demonstrated reduced compound muscle action potentials in the peroneal and tibial nerves with preserved sensory nerve action potentials, a hallmark of LMN disease (11). Needle electromyography revealed a neurogenic pattern with chronic denervation and reinnervation changes, reduced recruitment, and fasciculations, confirming lower motor neuron involvement .(12) These findings align with established diagnostic criteria, including the revised El Escorial and Awaji guidelines, which emphasize electrophysiological confirmation of motor neuron pathology. The presence of previous lumbar laminectomy initially raised the possibility of post-surgical radiculopathy; however, widespread EMG abnormalities beyond the surgical site, preserved sensory conduction, and progressive clinical course supported a diagnosis of LMN-predominant MND rather than focal post-laminectomy deficits .(7)

Clinical management of LMN-predominant MND focuses on functional preservation and quality-of-life enhancement rather than disease modification, as no curative therapy exists. Multidisciplinary care is recommended, incorporating neurologists, physiotherapists, occupational therapists, and caregivers (13). In this case, a structured physiotherapy program was implemented with goals including maintenance of lower limb strength, balance enhancement, gait re-education, endurance optimization, and prevention of secondary complications such as contractures and falls. Exercise intensity was carefully titrated to prevent overfatigue, a crucial consideration in LMN disease due to reduced motor unit reserve and early fatigability. Evidence supports low-intensity, submaximal strengthening and functional task training as safe and beneficial interventions that can slow functional decline without accelerating disease progression.

CONCLUSION

Motor neuron disease is a progressive neurodegenerative disorder requiring early and accurate diagnosis. Tailored physiotherapy within a multidisciplinary approach helps maintain functional independence and quality of life.

Standardized outcome measures are essential for monitoring disease progression and rehabilitation outcomes.

Abbreviations

· MND – Motor Neuron Disease

· LMN – Lower Motor Neuron

· UMN – Upper Motor Neuron

· ALS – Amyotrophic Lateral Sclerosis

· PMA – Progressive Muscular Atrophy

· EMG – Electromyography

· NCS – Nerve Conduction Study

· MRI – Magnetic Resonance Imaging

Declarations

Ethics approval and consent to participate

Ethical approval was obtained from the Institutional Ethics Committee prior to the study. Written informed consent was obtained from the patient before participation in the study.

Consent for publication

Written informed consent was obtained from the patient for publication of this case report and any accompanying images. All identifying information has been anonymised to maintain confidentiality.

Availability of data and materials

All data generated or analysed during this study are included in this published article.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

Purvi Jadhwani contributed to patient assessment, data collection, physiotherapy intervention, and manuscript drafting.

Irshad Qureshi contributed to study conception, clinical supervision, manuscript review, and final approval.

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Figures



Figure 1

Pelvic bridging exercise performed as part of the physiotherapy intervention program.