DOI 10.36803/indojpmr.v14i2.516

Indonesian Journal of Physical Medicine and Rehabilitation | Volume 14, Issue 02, 2025

CASE REPORT

Comprehensive Rehabilitation in Systemic Sclerosis with Complex Neurological Involvement: A Case Report

Short running title: Complex Systemic Sclerosis Rehabilitation

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ABSTRACT

Introduction: Systemic sclerosis (SSc) is a chronic autoimmune disorder characterized by fibrosis and vascular dysfunction affecting multiple organ systems. Neurological and pulmonary complications, though less common, can markedly worsen disability and impair quality of life. Multidisciplinary rehabilitation plays a crucial role in optimizing function, yet evidence in complex SSc cases remains limited.

Case Presentation: A 65-year-old woman with known SSc developed progressive rigidity, mixed axonal–demyelinating polyneuropathy confirmed by electrodiagnostic studies, interstitial lung disease with an NSIP pattern on HRCT, and significant nutritional decline. She presented with bedridden status, marked balance impairment, stocking–glove sensory loss, digital ischemia, poor exercise tolerance, and complete dependence in mobility and self-care. An individualized inpatient rehabilitation program was initiated, including gradual mobility and strengthening exercises, adaptive self-care training, pulmonary rehabilitation, nutritional optimization, and psychological support. Over several weeks, she demonstrated measurable improvements in supervised ambulation with a walker, independence in daily activities, reduction of neuropathic symptoms, enhanced nutritional intake, and improved sleep.

Discussion: This case illustrates the compounded functional burden imposed by the coexistence of neurological and pulmonary manifestations in SSc. Polyneuropathy further limits mobility, while interstitial lung disease contributes to fatigue, dyspnea, and exercise intolerance. The patient's meaningful gains highlight the importance of early, coordinated rehabilitation approaches tailored to multisystem impairment. Strengthening, balance retraining, pulmonary conditioning, and nutritional support can produce synergistic benefits, even in severe disease stages.

Conclusion: Comprehensive, individualized multidisciplinary rehabilitation can substantially enhance functional outcomes and quality of life in patients with systemic sclerosis complicated by neurological and pulmonary involvement. Early referral and integrated management are essential to mitigate disability and optimize recovery.

Keywords: systemic sclerosis; polyneuropathy; interstitial lung disease; rehabilitation; functional recovery

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INTRODUCTION

Systemic sclerosis (SSc) is a progressive autoimmune connective tissue disease characterized by fibrosis, microvascular abnormalities, and involvement of multiple organ systems. In recent years, its management has advanced considerably, supported by recommendations from the European Alliance of Associations for Rheumatology and the British Society for Rheumatology, both of which emphasize the importance of coordinated multidisciplinary care.[1,2] Although neurological complications have often been considered uncommon, current evidence suggests they occur more frequently than previously recognized and contribute meaningfully to the overall burden of disability.[3,4]

Peripheral nerve involvement in SSc may result from autoimmune injury, chronic microvascular compromise, entrapment neuropathies, or medication-related neurotoxicity. [5] These mechanisms can impair functional capacity and limit daily activities, and the challenges become even greater when neuropathy occurs alongside pulmonary involvement such as interstitial lung disease. Neuromuscular and respiratory impairments that appear simultaneously often accelerate functional decline and reduce independence.

Rehabilitation has become an increasingly important component of SSc management. Structured programs have been shown to help maintain functional capacity, improve respiratory performance, and support participation in meaningful activities. [6,7] However, clinical reports that describe rehabilitation approaches tailored for patients who experience both neurological and pulmonary complications are still limited. This lack of detailed guidance presents practical challenges for clinicians who must design individualized programs for patients with complex multisystem presentations.

The present case is reported to illustrate these challenges by describing a patient with systemic sclerosis who developed both polyneuropathy and pulmonary involvement. It also demonstrates how a coordinated rehabilitation program addressing neurological, respiratory, and nutritional domains can support meaningful functional recovery in a condition that is otherwise progressive and difficult to manage. The aim of this case report is to describe the clinical features, the rehabilitation approach implemented, and the functional outcomes observed in this patient.

CASE DESCRIPTION

A 65-year-old woman with previously diagnosed systemic sclerosis (SSc) was admitted to our rehabilitation unit with a six-month history of progressive whole-body stiffness and increasing dependency in activities of daily living. Her condition initially emerged in December 2022 with facial tightening and perioral discomfort. She was evaluated at a local hospital and treated for presumed ischemic stroke. Cranial CT at that time revealed chronic lacunar infarcts in the right basal ganglia (Figure 1).

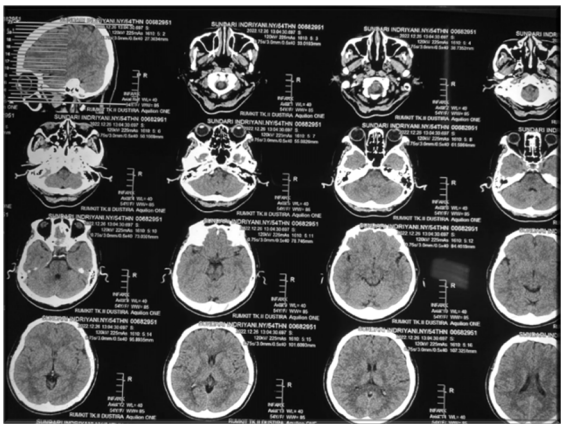

Figure 1. CT head demonstrating chronic lacunar infarcts in the basal ganglia region

Her symptoms gradually progressed. By April 2023, stiffness extended to all extremities, accompanied by a burning and tingling sensation in both hands and feet. Digital discoloration developed when extremities were dependent, and she experienced worsening difficulty in performing fine motor and self-care activities. Functional deterioration continued throughout the year, resulting in limited mobility, inability to ambulate, decreased oral intake, and marked weakness. A summary of her clinical progression is illustrated in Figure 2.

Tabel 1. Clinical timeline demonstrating progressive functional decline from December 2022 to admission.

Time Period	Key Clinical Progression	Functional Impact & Management
December 2022	• Onset of discomfort around the mouth and facial stiffness • Cyanosis at fingertips when hands were dependent	• Evaluated by Neurology, initially treated as ischemic stroke for 3 days • Discharged with oral antiplatelet therapy • No significant residual disability
April 2023	• Stiffness progressed to upper and lower limbs • Intermittent neuropathic pain • Worsening digital discoloration suggestive of peripheral ischemia	• Decline in ADL performance • Weight loss began to be noticeable
Late 2023	• Severe whole-body stiffness • Skin tightening and sclerosis becoming more pronounced	• Became progressively bedridden • Full dependence for mobility and self-care
At Hospital Admission for Rehabilitation	• Distal muscle weakness • Stocking-glove sensory impairment • Malnutrition and poor oral intake • Exertional dyspnea due to ILD	• Initiated multidisciplinary inpatient management: neurology, pulmonology, nutrition, and intensive rehabilitation program

On physical examination, she required maximal assistance for bed mobility and transfers and was unable to stand or walk. Distal muscle weakness was evident in both hands and feet, and sensory examination showed reduced vibration and proprioception in a stocking–glove distribution. Sitting balance was significantly impaired, with marked postural sway. Dermatologic assessment revealed sclerodactyly, hyperpigmentation, and ischemic changes in the digits (Figure 2). After rehabilitation, modest improvement in skin softening and distal perfusion was observed (Figure 3).

Electrodiagnostic testing demonstrated reduced compound muscle action potential amplitudes, slowed nerve conduction velocities, fibrillation potentials, and rapid recruitment patterns on EMG, confirming a mixed axonal–demyelinating polyneuropathy (Figure 4).

Figure 2. Pre-rehabilitation acral tightening with pigmentary changes.

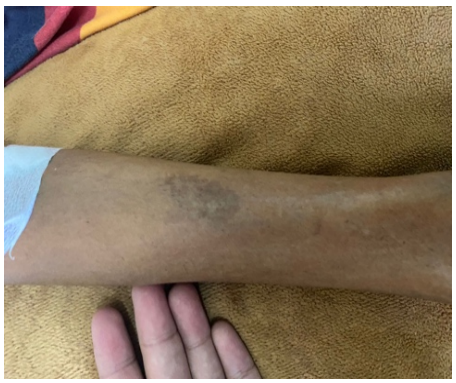

Figure 3. Post-rehabilitation improvement in color and soft tissue flexibility

Table 1. F-Wave Study

Nerve / Site	F-Lat	Lat Norm
Right Median (APB)	28.30	< 30
Right Peroneal (EDB)	46.55	< 56
Right Tibial (Abd Hallucis)	48.42	< 61
Right Ulnar (ADM)	23.63	< 36

Table 2. H-Reflex Study

Nerve / Side	H-Lat (ms)	H-Lat Norm	L-R- Lat Norm
Left Tibial (Gastrocnemius)	**31.50**	0.32	**<2.0**
Right Tibial (Gastrocnemius)	**31.06**	0.32	**<2.0**

Tabel 3. EMG Summary

Side	Muscle	Nerve	Root	Insertion Activity	Fibs	PSW	Amplitude	Duration	Polypasic	Recruitment	Interferent Pattern	Comment
Left	Ant Tibialis	Deep Peron	L4-5	Nml	**Nml**	**Nml**	**Desc**	**Nml**	**0**	**Rapid**	**Nml**	
Left	Deltoid	Axillary	C5-6	Nml	Nml	Nml	**Desc**	**Nml**	**0**	**Rapid**	**Nml**	
Left	Bicep	Musculocut	C5-6	Nml	**1+**	Nml	**Desc**	**Nml**	**0**	**Rapid**	**Nml**	
Left	Gastro	Tibial	S1-2	Nml	**1+**	1+	**Nml**	**Nml**	**0**	**Rapid**	**Nml**	
Left	Post Deltoid	Axillary	C5-6	Nml	Nml	Nml	Nml	Nml	0	Nml	**Nml**	
Left(Post Inj)	Biceps	Musculocut	C5-6	Nml	Nml	Nml	Nml	Nml	0	Nml	**Nml**	

Table 4. Motor Summary

Nerve / Muscle	NR	Onset (ms)	Norm Onset	O-P Amp	Norm O-P Amp	Site 1	Site 2	Delta-D	Dist	Vel	Norm Vel
Right Median Motor (APB)	–	**5.7**	<4.5	**1.2**	>5.5	Elbow	Wrist	**4.4**	**21.0**	**48**	>50
Right Peroneal Motor (EDB)	–	**6.2**	<4.6	**0.6**	>3.3	B Fib	Ankle	**5.4**	**27.0**	**>45**	>45
Right Tibial Motor (Abd Hall Brev)	–	**3.8**	<4.6	**5.9**	>5.0	Knee	Ankle	**7.0**	**35.0**	**>42**	>42
Right Ulnar Motor (Abd Dig Minimi)	–	**4.4**	<3.0	**1.7**	>7.0	Elbow	Wrist	**3.2**	**18.0**	**56**	>50

Tabel 5. Anti Sensory Summary

Stim Site	Onset	Normal Onset	NR	Peak	Norm Peak	O-P Amp	Norm O-P Amp	Site1	Site2	Delta-0	Dist	Vel	Norm Vel(m/s)
Right Median (2nd Digit)	3.4	<3.9		4.2	-	15.6	>14	Wrist	2nd Digit	3.4	14.0	41	>39
Right Sup Peron (Ant Lat Mall)	2.8	<3.1		3.3	-	1.6	>7.0	14 cm	Ant Lat Mall	2.8	11.0	39	>32
Right Sural (Lat Mall)	2.9	<3.8		3.7	-	8.8	>7.0	Calf	Lat Mall	2.9	17.0	59	>33
Right Ulnar (5th Digit)	2.4	<3.0		3.1	-	11.4	>9.0	Wrist	5th Digit	2.4	14.0	58	>38

Figure 2 EMG–NCS upon admission showing neurogenic involvement of both sensory and motor nerves

Electroencephalography revealed bilateral temporal slowing without epileptiform activity (Figure 5). Brain MRI showed periventricular and subcortical white matter hyperintensities (Fazekas grade 2), consistent with cerebral small-vessel changes frequently associated with systemic sclerosis.

Pulmonary assessment confirmed interstitial lung disease with NSIP pattern on HRCT (Figure 6). The severe stiffness, episodic spasms, and EMG abnormalities raised clinical suspicion of a stiff-person syndrome overlap with SSc.

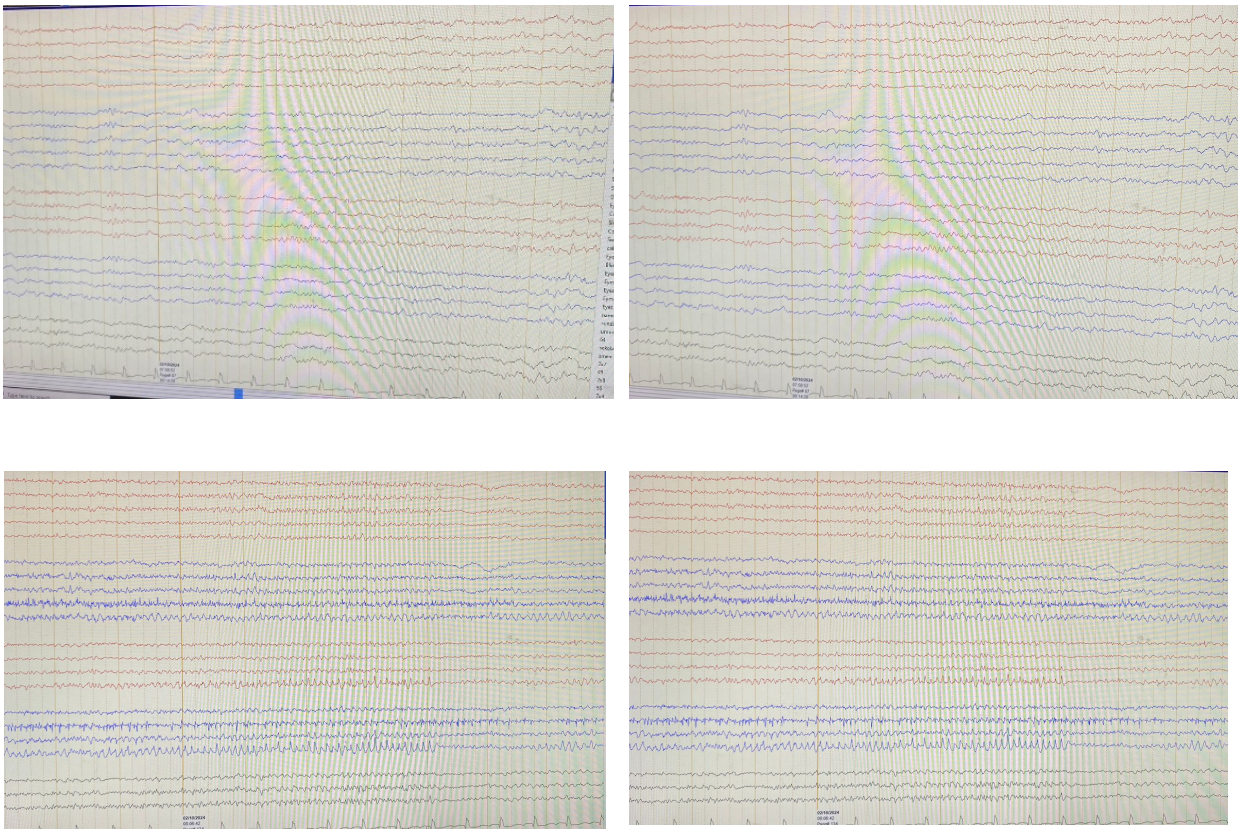

Figure 3. EEG showing bilateral temporal cortical dysfunction without seizure discharges.

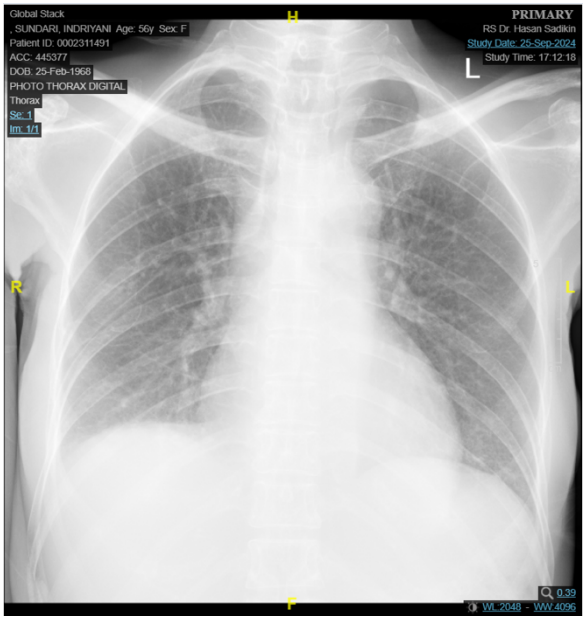

Figure 4. HRCT of thorax demonstrating NSIP-pattern reticulations and ground-glass opacities.

Nutritional evaluation revealed significant weight loss and hypoalbuminemia, requiring nasogastric tube feeding. She had been receiving high-dose diazepam and pregabalin prior to admission with minimal improvement. A multidisciplinary rehabilitation strategy was initiated, including physiotherapy focusing on graded mobility and balance, occupational therapy using adaptive equipment and joint protection, pulmonary rehabilitation with monitored endurance training, nutritional optimization, and psychological support to address anxiety and sleep disruption.

Baseline functional status before rehabilitation is detailed in Table 2.

Tabel 2 Baseline Functional Status Before Rehabilitation

Functional Domain	Findings at Admission
Ambulation	Bedridden; maximal assistance
Transfers	Fully dependent
Sitting balance	Severe instability; requires support
Hand function	Unable to perform feeding and dressing
Pain & stiffness	Severe daily symptoms affecting sleep
Nutrition	Severe protein-calorie malnutrition; NGT needed
Exercise tolerance	Dyspnea with minimal exertion
Sleep	Poor quality; frequent interruptions

After weeks of continuous multidisciplinary intervention, notable functional gains were achieved. The patient regained independent bed mobility and was able to ambulate short distances with a walker under supervision. She also regained independence in basic self-care tasks using adaptive strategies. Neuropathic pain reduced in both intensity and frequency, her sleep improved, and oral intake became sufficient, allowing removal of the nasogastric tube. Post-rehabilitation outcomes are summarized in Table 3. These improvements indicate meaningful recovery despite multisystem involvement.

Tabel 3 Functional Outcomes After Rehabilitation

Functional Domain	Status After Rehabilitation
Ambulation	Short-distance ambulation with walker; minimal assist
Transfers	Modified independence
Sitting balance	Maintains posture unsupported while performing tasks
Hand function	Independent in grooming and dressing with adaptations
Pain & stiffness	Reduced frequency and severity
Nutrition	Adequate oral intake; NGT discontinued
Exercise tolerance	Improved endurance; reduced dyspnea
Sleep	Improved continuity and restorative sleep

DISCUSSION

This case highlights the complexity of neurological and functional deterioration in systemic sclerosis (SSc), particularly when complicated by mixed sensorimotor polyneuropathy, interstitial lung disease, and progressive nutritional decline. The combined impact of peripheral nerve dysfunction and respiratory impairment created profound challenges in mobility, balance, and activity tolerance, ultimately resulting in loss of independence in daily living activities.

A structured multidisciplinary rehabilitation program was delivered in close coordination with medical management. Physiotherapy sessions were conducted daily for approximately 30–45 minutes, targeting gentle stretching adapted for skin tightening, progressive strengthening of proximal and distal muscle groups, postural retraining, gait re-education, and sitting balance exercises to compensate for impaired proprioception. Occupational therapy incorporated joint protection strategies, energy conservation techniques, and task-specific training to restore self-care performance using adaptive tools as needed. Pulmonary rehabilitation interventions guided by American Thoracic Society recommendations included breathing technique training, monitored aerobic conditioning, and pacing strategies to optimize dyspnea control in the presence of interstitial lung disease. Nutritional intervention involved gradual improvement in oral intake and adjustment of calorie–

protein targets, while psychological support enhanced coping and sleep quality.

Following this coordinated rehabilitation, the patient demonstrated meaningful functional recovery. Ambulation progressed from requiring constant assistance to independent walking with an assistive device. Dexterity and upper-limb coordination improved, enabling autonomous grooming and dressing. Neuropathic pain frequency decreased, sleep quality improved, and the patient reported feeling "more confident and less afraid to move," reflecting positive patient-reported outcomes. Despite persistent underlying pulmonary restriction, endurance increased, with reduced dyspnea during functional ambulation. Weight stabilization and gradual nutritional improvement further reduced fatigue and supported physical gains.

These findings align with prior reports showing that individualized rehabilitation improves mobility, hand function, and quality of life in SSc patients. Murphy et al. (2022) demonstrated significant gains from physiotherapy–occupational therapy integration, while Špiritović et al. (2022) reported sustained functional independence after long-term multidisciplinary intervention. Additionally, evidence supports pulmonary rehabilitation as a beneficial adjunct in SSc-associated lung disease to enhance exercise tolerance and daily functioning. Taken together, available literature reinforces the principle that early and continuous rehabilitation may counterbalance functional deterioration despite progressive systemic disease.

This case underscores the critical role of rehabilitation as a therapeutic bridge directly addressing functional limitations that disease-modifying treatments alone cannot resolve. Even though recovery was not complete and residual symptoms persisted, achieving regained independence, reduced disability burden, and improved patient satisfaction marks a meaningful clinical success. Thus, multidisciplinary rehabilitation should be considered a standard component of SSc care, particularly when neurological complications compromise quality of life.

CONCLUSION

This case report demonstrates that coordinated multidisciplinary rehabilitation can lead to clinically meaningful improvements in mobility, self-care independence, symptom control, and nutritional stability in a patient with systemic sclerosis complicated by polyneuropathy and interstitial lung disease. The outcomes highlight the importance of early screening for functional decline and timely rehabilitation referral in SSc populations. Integrating individualized rehabilitation alongside disease-modifying therapy provides a practical and evidence-supported model for optimizing daily functional capacity and patient well-being in similarly complex presentations.

ACKNOWLEDGMENTS

The authors acknowledge the dedication of the multidisciplinary rehabilitation team whose collaborative expertise enabled the successful outcomes described. We express gratitude to our patient for her commitment to the rehabilitation process and for providing informed consent for educational publication.

AUTHOR CONTRIBUTIONS

P.R.A. designed the treatment protocol, coordinated multidisciplinary care, and prepared the manuscript. V.B. implemented rehabilitation interventions and contributed to outcome assessment. A.N. provided senior clinical supervision and manuscript review. All authors participated in final manuscript approval.

FUNDING

This case report received no specific funding from any organization.

ETHICAL APPROVAL AND PATIENT CONSENT

Written informed consent for publication was obtained from the patient.

CONFLICT OF INTEREST

The authors declare no financial or personal conflicts of interest related to this case report.

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