

Case Report

Integrated Multimodal Rehabilitation in an Elderly Patient with Pulmonary Fibrosis: A 24-Month CARE-Compliant Case Report

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Abstract

Pulmonary fibrosis is a progressive interstitial lung disease characterized by exertional dyspnea, impaired exercise tolerance, hypoxemia, and functional decline. Elderly individuals with pulmonary fibrosis frequently experience additional musculoskeletal, cognitive, and balance-related impairments that further compromise independence and quality of life. While pulmonary rehabilitation is recommended as an adjunctive therapy, evidence regarding long-term multidisciplinary rehabilitation approaches remains limited.

We report the case of a 69-year-old female with pulmonary fibrosis complicated by osteoporosis, bilateral hip hairline fractures, obstructive sleep apnoea, and mild cognitive impairment who underwent a structured multimodal rehabilitation program over 24 months. Baseline evaluation demonstrated severe functional limitation with resting oxygen saturation (SpO₂) of 86% on room air, mMRC dyspnea grade 3, impaired mobility, high fall risk, disturbed sleep, and prior dependence on supplemental oxygen and BiPAP support.

The rehabilitation program combined graded physiotherapy, breathing retraining/pranayama, and cognitive rehabilitation delivered in phased progression according to symptom tolerance and functional capacity. Over the 24-month follow-up period, the patient demonstrated clinically meaningful improvements in resting oxygen saturation (86% to 98%), six-minute walk distance (120 m to 280 m), dyspnea severity (mMRC grade 3 to grade 1), balance, mobility, sleep quality, and functional independence. Supplemental oxygen and BiPAP support were discontinued during follow-up. No intervention-related adverse events were observed.

This case highlights the potential role of long-term integrated rehabilitation as a safe and effective adjunct to standard medical management in pulmonary fibrosis, particularly in elderly patients with multisystem functional decline. Further controlled studies are required to evaluate the reproducibility and efficacy of multimodal rehabilitation approaches in interstitial lung disease.

Introduction

Pulmonary fibrosis is a chronic interstitial lung disease characterized by progressive scarring of the lung parenchyma, impaired gas exchange, reduced exercise tolerance, and declining functional capacity [1,2]. Patients commonly present with exertional dyspnea, fatigue, reduced endurance, and progressive limitation in activities of daily living [2,3]. In elderly individuals, these respiratory limitations are frequently

compounded by frailty, musculoskeletal impairment, sleep disturbances, anxiety related to breathlessness, and cognitive dysfunction, collectively contributing to loss of independence and reduced quality of life [3,4].

Current management strategies for pulmonary fibrosis primarily focus on pharmacological disease modification and symptom management [1]. Although antifibrotic therapy may slow disease progression, it often does not adequately

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address deconditioning, balance impairment, functional decline, or psychosocial consequences associated with chronic respiratory disease [2,3]. Pulmonary rehabilitation has therefore emerged as an important adjunctive intervention to improve exercise tolerance and symptom burden in interstitial lung disease [5,6].

Existing rehabilitation literature in pulmonary fibrosis has largely focused on short-duration exercise-based pulmonary rehabilitation programs [6,7]. Evidence regarding long-term, multidisciplinary rehabilitation models integrating physical conditioning, breathing retraining, cognitive rehabilitation, and functional independence strategies remains limited, particularly in elderly patients with multiple comorbidities [6,8].

This manuscript is presented as a CARE-compliant clinical case report describing the longitudinal outcomes of a structured multimodal rehabilitation program delivered over 24 months in an elderly female with pulmonary fibrosis and associated multisystem functional decline [9].

Case presentation

A 69-year-old retired homemaker was diagnosed with pulmonary fibrosis in December 2023 following a pulmonology evaluation for progressive exertional breathlessness and fatigue. The patient reported worsening dyspnea during household activities, disturbed sleep, reduced mobility, fear of exertion, and declining confidence in performing daily activities independently.

Her medical history was significant for:

- Osteoporosis
- Bilateral hip hairline fractures were managed conservatively.
- Obstructive sleep apnoea
- Mild cognitive decline affecting attention and short-term memory

She was a non-smoker with no history of alcohol consumption. Before intervention, the patient had adopted a predominantly sedentary lifestyle because of progressive breathlessness and fear of falls.

At baseline evaluation:

- Resting oxygen saturation on room air was 86%
- Dyspnea severity was mMRC grade 3
- Ambulation was slow and guarded
- Functional mobility required external support
- Fall risk was high due to poor balance and lower-limb weakness

- Sleep was fragmented with frequent nocturnal awakenings
- The patient had a prior history of supplemental oxygen and BiPAP use for symptom management

Mild cognitive difficulties involving attention span, task sequencing, and recall were observed during clinical interaction and functional assessment [4,8]. These deficits contributed to reduced confidence during mobility and daily activities.

The patient continued standard medical management under the supervision of her treating pulmonologist throughout the rehabilitation period, including prescribed antifibrotic and supportive pharmacological therapy along with routine clinical follow-up.

Intervention

The patient underwent a structured multidisciplinary rehabilitation program under the MHITR (Mental Health Innovations and Therapeutic Research) Vayofit Integrated Rehabilitation Model. The program combined physiotherapy, breathing retraining/pranayama, and cognitive rehabilitation in a phased progression approach, individualized according to symptom tolerance, oxygenation response, fatigue levels, and functional status.

Sessions were initially conducted six days per week for approximately 90 minutes daily during the early rehabilitation phase and were later reduced to three days per week during maintenance phases. The intervention was delivered through supervised sessions combined with guided home-based practice.

Physiotherapy intervention

The physiotherapy component focused on [5,6]:

- Breathing retraining
- Graded physical conditioning
- Balance rehabilitation
- Functional mobility restoration
- Fall prevention
- Endurance improvement

Early rehabilitation phase (weeks 0–12)

The initial phase prioritized safety, symptom stabilization, and prevention of further deconditioning.

Interventions included:

- Diaphragmatic breathing
- Pursed-lip breathing during exertion



- Supported ambulation
- Bedside marching
- Assisted sit-to-stand training
- Low-resistance strengthening exercises
- Core stabilization exercises
- Structured pacing strategies

Exercise intensity remained low to minimize exertional desaturation and fracture-related risk [5].

Intermediate rehabilitation phase (months 3–12)

As exercise tolerance improved, rehabilitation progressed toward endurance and balance training.

Interventions included:

- Timed walking programs
- Progressive resistance exercises
- Static and dynamic balance training
- Gait re-education
- Postural correction
- Functional mobility drills

Advanced functional phase (months 12–24)

The final phase emphasized functional independence and real-world task performance.

- Interventions included:
- Functional strengthening
- Stair-climbing practice
- Advanced balance training
- Dual-task gait activities
- Maintenance endurance conditioning

Progression was individualized according to:

- Oxygen saturation response
- Dyspnea severity
- Pain levels
- Fatigue thresholds
- Functional recovery

Continuous monitoring was performed during sessions, including:

- Resting and exertional SpO₂

- Dyspnea perception
- Fatigue response
- Pain levels

No physiotherapy-related adverse events occurred during the intervention period.

Breathing retraining and pranayama intervention

Breathing retraining techniques, including structured pranayama-based exercises, were incorporated to improve breathing efficiency, autonomic regulation, anxiety related to dyspnea, and respiratory pacing during activity [10,11].

- The intervention emphasized:
- Slow, controlled breathing
- Non-forceful respiratory exercises
- Breath-awareness techniques
- Relaxation-based breathing regulation [10]

Forceful breathing techniques and breath retention practices were avoided because of the patient's respiratory limitation and skeletal fragility.

Early phase

- Initial breathing practices focused on:
- Diaphragmatic breathing
- Pursed-lip breathing
- Slow breathing regulation
- Guided relaxation
- Breath awareness

The primary goals were:

- Reduction of dyspnea-related anxiety
- Improvement in breathing coordination
- Reduction in accessory muscle overuse

Intermediate phase

As respiratory stability improved, interventions progressed to:

- Sectional thoracic breathing
- Gentle alternate nostril breathing
- Slow breath-linked movement exercises
- Guided relaxation and meditation practices



Maintenance phase

The final phase emphasized:

- Functional breathing during activities of daily living
- Breath pacing during ambulation
- Breath-linked mobility exercises
- Mindfulness-based breath awareness

Breathing exercises were modified according to symptom tolerance and oxygen saturation response. No breathing-related adverse events or desaturation episodes requiring termination of sessions were observed.

Cognitive rehabilitation

Cognitive rehabilitation was introduced after the third month of intervention, once respiratory stability, sleep quality, and exercise tolerance had improved sufficiently to support sustained cognitive engagement.

The cognitive program focused on:

- Attention restoration
- Sleep stabilization
- Functional memory
- Executive function
- Dual-task integration [4,8]

Interventions were designed around meaningful household and daily-life activities to minimize performance anxiety and improve adherence.

Examples included:

- Object sorting tasks
- Functional sequencing activities
- Memory recall exercises
- Household planning tasks
- Guided attentional exercises
- Dual-task walking activities

The rehabilitation approach emphasized:

- Gradual cognitive loading
- Emotionally safe task engagement
- Functional relevance
- Integration with mobility and breathing strategies
- No cognitive distress or intervention-related fatigue requiring discontinuation occurred during follow-up.

Outcomes

The patient demonstrated progressive improvement across physiological, functional, and symptom-related outcome measures throughout the 24-month follow-up period.

Table 1: Longitudinal Clinical Outcomes

Parameter	Baseline	12 Months	24 Months
Resting SpO ₂ (room air)	86%	94%	98%
mMRC Dyspnea Grade	3	2	1
Six-Minute Walk Distance	120 m	210 m	280 m
Supplemental Oxygen Use	Required	Reduced/intermittent	Discontinued
BiPAP Support	Required	Reduced	Discontinued
Balance/Fall Risk	High	Moderate	Low
Functional Independence	Assisted mobility	Partial independence	Independent household mobility

Oxygenation

Resting oxygen saturation progressively improved from 86% at baseline to 98% at final follow-up on room air.

Exercise tolerance

The six-minute walk distance improved from 120 meters to 280 meters, reflecting substantial improvement in endurance and functional mobility [12].

Dyspnea

Dyspnea severity improved from mMRC grade 3 to grade 1, with the patient reporting significantly reduced breathlessness during activities of daily living [3].

Functional recovery

The patient transitioned from assisted ambulation to independent household mobility and demonstrated improved confidence in performing daily tasks.

Sleep and cognitive function

The patient reported improved sleep continuity, reduced anxiety related to breathlessness, and improved attentional endurance during daily activities.

No adverse events, falls, fractures, or rehabilitation-related complications were observed during the intervention period.

Discussion

This case demonstrates clinically meaningful improvement in oxygenation, exercise tolerance, dyspnea severity, and functional independence following a long-term multimodal rehabilitation program in an elderly patient with pulmonary fibrosis and multiple comorbidities [6,7].

Pulmonary rehabilitation is recognized as an important adjunctive therapy in interstitial lung disease and has been shown to improve exercise capacity and symptom burden [5,6]. However, most rehabilitation studies in pulmonary fibrosis have focused primarily on short-duration exercise programs. This case extends existing literature by



demonstrating sustained long-term functional improvement using an integrated rehabilitation approach delivered over 24 months.

Several mechanisms may explain the observed improvements. Progressive physical conditioning likely contributed to improved peripheral muscle efficiency, reduced deconditioning, and enhanced exercise tolerance [5]. Breathing retraining may have improved ventilatory coordination, reduced dyspnea-related anxiety, and optimized breathing patterns during exertion [10,11]. Balance rehabilitation and graded mobility training likely contributed to reduced fall risk and increased confidence during ambulation.

An important aspect of this case was the integration of cognitive rehabilitation with physical rehabilitation. Chronic hypoxemia, sleep disturbance, anxiety, and reduced physical activity may collectively contribute to cognitive dysfunction in chronic respiratory disease [4,8]. The gradual introduction of attention, memory, and dual-task activities may have supported safer mobility and improved confidence in functional tasks.

The patient's adherence to rehabilitation over a prolonged period was another clinically significant observation. Long-term adherence remains a major challenge in pulmonary rehabilitation, particularly in elderly individuals with frailty and multiple comorbidities. The individualized, graded, and symptom-guided approach may have contributed to sustained participation and safety.

Future integrated pulmonary rehabilitation frameworks may additionally benefit from emerging digital respiratory health technologies, including wearable physiological monitoring, AI-assisted respiratory assessment systems, and personalized rehabilitation analytics to support long-term patient monitoring and adaptive intervention strategies. Advances in digital pulmonary care may help improve rehabilitation personalization, adherence tracking, and longitudinal functional assessment in chronic respiratory disease populations.

This report has several limitations. As a single-case observational report, causal inference cannot be established [12]. Improvements may have been influenced by ongoing medical management, lifestyle modifications, or natural variability in disease progression. Additionally, objective pulmonary measures such as serial pulmonary function testing, diffusion capacity assessment, chest CT quantification, or imaging-based fibrosis progression analysis were unavailable within the scope of this rehabilitation program. Future studies incorporating standardized pulmonary imaging, physiological markers, and longitudinal radiological assessment may further clarify the relationship between integrated rehabilitation and functional outcomes in pulmonary fibrosis.

Despite these limitations, the magnitude and durability of improvements observed in this patient support further investigation of integrated rehabilitation approaches in interstitial lung disease populations.

Conclusion

This case demonstrates that long-term multidisciplinary rehabilitation combining physiotherapy, breathing retraining, and cognitive rehabilitation may be safely integrated into the management of pulmonary fibrosis in elderly individuals with multisystem functional decline.

The observed improvements in oxygenation, exercise tolerance, dyspnea, balance, sleep quality, and functional independence highlight the potential role of structured multimodal rehabilitation as an adjunct to standard medical management in pulmonary fibrosis.

Further controlled studies are required to evaluate reproducibility, mechanisms, and long-term efficacy of integrated rehabilitation models in interstitial lung disease.

Ethics and consent

Written informed consent was obtained from the patient for publication of this case report and associated clinical data. The intervention was conducted under structured clinical supervision within the MHITR Vayofit rehabilitation program.

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