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Dual Disability Rehabilitation: Addressing Complex patient need- A case series

Sanyal Kumar[1*], Debasish Jena[2], Anjani Kumar[3]

[1]MBBS, MD (PMR) (Assistant Professor), Department of Physical Medicine & Rehabilitation, All India Institute of Medical Sciences, Patna, India.

[2]MBBS, MD (PMR), Consultant, Department of Pain Medicine, IGKC Multispecialty Hospital, Bhubaneswar, Odisha, India.

[3]MBBS, MD (PMR) (Assistant Professor), Department of Physical Medicine & Rehabilitation, All India Institute of Medical Sciences, Patna, India.

Corresponding Author: Dr. Sanyal Kumar, Department of PM&R, All India Institute of Medical Sciences, Phulwari Sharif, Patna-801507, India.

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Abstract

This case series presents an in-depth analysis of rehabilitation approaches for individuals with dual disabilities of spinal cord injury (SCI) and amputation. Focusing on a population in a low-income state in eastern India, the study highlights the intricate interplay between these two conditions and their implications for functional recovery and independence. Detailed case analyses illustrate the strategies adopted for medical management, mobility training, and prosthetic adaptation in individuals with coexisting SCI and limb loss. The findings emphasize the critical role of a multidisciplinary rehabilitation team in addressing the complex interplay of functional limitations and optimizing outcomes. This series underscores the need for individualized rehabilitation plans that leverage available resources and foster improved quality of life for individuals with dual disabilities.

Keywords: Spinal cord injury, Amputation, Rehabilitation, Low-income, Disability.

Abbreviations

SCI: Spinal Cord Injury

ASIA: American Spinal Injury Association

ASIA-A & C: ASIA Impairment Scale - Grade A and C

LEMS: Lower Extremity Motor Score

UEMS: Upper Extremity Motor Score

PSSPLS: Posterior Spinal Stabilization with Pedicle Screw and Plate System

T4, T10, T12/L1, C5, L1: Spinal Cord Neurological Levels

NPSI: Neuropathic pain symptom inventory

Introduction

The combination of spinal cord injury (SCI) and limb amputation presents a uniquely challenging rehabilitation scenario, as each condition independently demands extensive medical and therapeutic care. When combined, these conditions create compounded difficulties for patients, requiring specialized, integrated approaches. For instance, the paralysis and loss of sensation associated with SCI can complicate the use of prosthetic limbs, while the presence of an amputation may limit the range of exercises typically employed in SCI rehabilitation to enhance muscle strength and mobility [1].

Effective management of these patients necessitates addressing the distinct challenges posed by both conditions. This includes managing neurogenic bladder and bowel dysfunction, preventing pressure ulcers, controlling spasticity, and ensuring proper stump care and wound healing [2, 3]. The risk of infections, particularly at the amputation site, is

elevated due to reduced mobility and impaired sensation, necessitating vigilant medical care [4].

Integrating prosthetic and orthotic devices is another critical challenge. Reduced motor control and the absence of sensory feedback in SCI patients can hinder the effective use of prostheses. Close collaboration between the rehabilitation team and prosthetist is essential to ensure optimal fit, functionality, and usability of these devices [5, 6].

Pain management is a cornerstone of care, as these patients often contend with phantom limb pain and neuropathic pain. Both conditions require a multimodal approach combining pharmacological interventions, physical therapy, and psychological support. Effective pain management is vital for enhancing patient participation in rehabilitation and improving their quality of life [7].

Achieving functional independence is a central goal of rehabilitation. This involves training patients in activities of daily living (ADLs), mobility skills, and the use of assistive devices. Tailored rehabilitation programs are essential to address the unique needs and capabilities of each patient, optimizing their functional outcomes [8, 9].

The psychological impact of dual disabilities is profound, often manifesting as depression, anxiety, or adjustment disorders. Comprehensive psychological support, including counseling and access to social services, is indispensable for helping patients navigate the emotional challenges of their disabilities and successfully reintegrate into their communities [10].

This narrative underscores the complexity of rehabilitating patients with SCI and limb amputation. It highlights the necessity of a multidisciplinary approach to address their intricate medical, functional, and psychological needs, ensuring holistic and effective care.

Case Scenario

1. 50 Yrs old female housewife, was involved in a train accident while trying to board a running train at platform (5-10 km/hrs), after the accident, her right limb was partially amputated below knee with both bone compound fracture with neurovascular deficit below umbilical region with bladder bowel involvement. At the tertiary care trauma center, the patient was diagnosed with spinal cord injury without radiological abnormality, neurological level T4, ASIA- A (Asia impairment scale), and UEMS-50 (Upper extremities motor score) LEMS-0 (Lower extremities motor score). Revision of amputation performed (guillotine type), for SCI patient managed conservatively. The patient was transferred to the rehabilitation department once stable. Rehabilitation strategies included stump revision for prosthetic fitting, wheelchair mobility training, upper limb strengthening, and bladder and bowel management through catheterization and bowel training. Psychological support and multimodal pain management with neuropathic medications. The patient's rehabilitation outcomes showed significant improvements across multiple parameters. The Functional Independence Measure (FIM) score increased from 24 pre-treatment to 76 post-treatment. There is no improvement in motor and sensory score. Neuropathic pain management was effective, as evidenced by a reduction in the Neuropathic Pain Symptom Inventory (NPSI) score from 75 to 45, demonstrating significant pain relief.
2. 30 Yrs old male electrician by occupation, met with a train accident when he try to board a running train at platform (5-10 km/hrs), after accident patient having open injury over right thigh with neurological deficit below umbilical region with bladder bowel involvement. At tertiary care trauma centre patient diagnosed SCI (complete translation injury at T12/L1) with neurological level T10, ASIA-A and LEMS-0 with crush injury around knee, Patient were operated for SCI, PSSPLS (Posterior Spinal Stabilization with Pedicle Screw and Plate System) performed and for external fixator were applied for crush injury after 2 days gangrene develop and patient undergone above knee amputation. Once stable, the patient was transferred to the rehabilitation unit., desensitization and prosthetic adaptation to improve mobility, alongside wheelchair training and bladder-bowel management. Pre and post treatment, Functional Independence Measure (FIM) score increased significantly from 32 pre-treatment to 72 post-treatment, reflecting marked improvements in daily living activities. The motor score and sensory score remain stable Neuropathic pain management yielded significant results, with the Neuropathic Pain Symptom Inventory (NPSI) score decreasing from 80 pre-treatment to 50 post-treatment, indicating effective pain relief and improved overall quality of life.
3. 50 Yrs old male shopkeeper by occupation, fall from height about 20 feet at night time, prior to the current accident around 10 yrs back patient get amputated for upper 1/3 rd transhumeral through machinery accident. At the day of injury patient experience neurological deficit below nipple region with bladder bowel involvement. At tertiary care trauma centre patient were diagnosed as a SCI (fracture dislocation) with neurological level C5, ASIA-A, UEMS-6 and LEMS-0. Patient managed conservatively for cervical cord injury and shifted to rehab unit once stable, Therapy emphasized powered wheelchair mobility, customized prosthetic adaptation, and upper limb strengthening for ADLs, coupled with counseling for body image concerns and comprehensive pain management. The patient's rehabilitation outcomes demonstrated modest improvements, particularly in functional independence and pain management. The Functional Independence Measure (FIM) score increased from 4 pre-treatment to 24 post-treatment, reflecting progress in basic daily living activities. The motor score, initially 6/100, showed slight improvement post-treatment, while the sensory score exhibited marginal enhancement from 35/224 pre-treatment. Neuropathic pain management was effective to some extent, with the Neuropathic Pain Symptom Inventory (NPSI) score decreasing from 85 pre-treatment to 60 post-treatment, indicating a reduction in pain intensity and some improvement in overall comfort.
4. 40 yrs old male labour by occupation, fall from height about 15 feet at their working site, after accident patient had neurological deficit below umbilicus with bladder and bowel involvement. At tertiary care trauma centre patient were diagnosed SCI (burst fracture L1) with neurological level L1, ASIA-A and LEMS-0 with fracture left femur. Patient managed with application of external fixator for fracture femur patient develop gangrene after 2 days and after 2 days of post injury PSSPLS performed for SCI and above knee amputation. Patient shifted to rehab unit once stable. In rehab unit patient were enrolled in SCI and amputee rehab programme. Skin graft care, intensive prosthetic training, and upper body strengthening for wheelchair mobility. Bladder-bowel management, mirror therapy for phantom pain, and vocational retraining were integral to his rehabilitation. The The Functional Independence Measure (FIM) score increased from 26 before therapy to 72 afterward, demonstrating improved ability to perform activities of daily living. The sensory and motor scores did not change. Effective pain control and an overall improvement in the patient's quality of life were demonstrated by the Neuropathic Pain Symptom Inventory (NPSI) score, which dropped from 78 before therapy to 52 after.

5. 56 Yrs old male farmer by occupation, met with train accident while boarding train at platform (running at 5-10 km/hrs), after accident patient had neurological deficit below umbilicus with bladder bowel involvement for this patient visited private hospital where he diagnosed SCI with neurological level L2, ASIA-C and LEMS-20 and PSSPLS performed, after 2 months of operation patient motor power and bladder bowel sensation regain and patient ambulate with orthosis prescribed by local practitioner, patient develop recurrent ulcer over right heel for this he took treatment from local practitioner and every episode of ulceration conservatively management advised for ulcer after 7-8 episode of ulceration, ulcer didn't heel with conservative management and after that patient left treatment and daily cleaning and dressing of ulcer performed by self, since 2 month when he attend rehab outpatient consultancy, patient develop swelling and profuse discharge from ulcer, at rehab unit patient diagnosed osteomyelitis right calcaneum with involve ankle and lower end tibia. For this patient amputated taranstibial, patient also were enrolled in SCI and amputee rehab programme. Orthotic-prosthetic integration and gait training to maximize residual motor power. His psychological rehabilitation focused on the long-term impact of recurrent ulcers and amputation, while functional training enabled his return to farming using adaptive tools. The patient's rehabilitation outcomes demonstrated notable advancements in functional independence and pain management. The Functional Independence Measure (FIM) score increased from 70 pre-treatment to 110 post-treatment, indicating significant improvements in daily living activities. The motor score, initially 70/100, showed slight enhancement with the aid of orthotic support, while the sensory score remained stable at 176/224. Neuropathic pain was effectively managed, as evidenced by a reduction in the Neuropathic Pain Symptom Inventory (NPSI) score from 65 pre-treatment to 40 post-treatment, contributing to an improved overall quality of life.

S. No.	Gender	Age	Occupation	Cause of Injury	SCI Type	SCI Level	SCI Fracture Type	Time of Operation (SCI)	Operation Type (SCI)	ASIA Level	Motor Score	Sensory Score	FIM (Admission)	FIM (Discharge)	S. No.	Amputee Region	Time of Amputation	Stump Condition	Cause of Injury	Phantom Limb Sensation or Pain	Neuropathic Pain
1	F	50 yr	House wife	Train accident	Closed	L1	Ant wedge collapse	Mx conservatively	Mx conservatively	C	64/100	136/224	24	76	1	Right transtibial	1 day	Skin healthy with discharging sinus	Compound fracture both bone leg	No	Yes
2	M	30 yr	Electrician	Train accident	Closed	T12, L1	Complete translation	After seven days	PSSPLS	A	50/100	136/224	32	72	2	Right transfemoral	2 days	No special	Crush injury fracture femur and both bone leg	No	Yes
3	M	50 yr	Shop keeper	FFH	Closed	C5, C6	Fracture dislocation	Mx conservatively	Mx conservatively	A	06/100	35/224	4	24	3	Right transfemoral	10 yrs prior injury	No special	Crush injury both bone forearm and humerus	No	Yes
4	M	40 yr	Labourer	FFH	Closed	L1	Burst fracture	8 days	PSSPLS	A	50/100	160/224	26	72	4	Left transfemoral	2 days	Grafted skin	Crush injury with fracture femur	No	Yes
5	M	36 yr	Farmer	Train accident	Closed	L2	Ant wedge collapse	2 weeks	PSSPLS	C	70/100	176/224	70	110	5	Right transtibial	12 yrs	No special	Non-healing ulcer with chronic osteomyelitis right calcaneum	No	No

Table: General Characteristics of Spinal Cord Injury and Amputee Conditions.

Assessment Tools

Rehabilitation outcomes were evaluated using several assessment tools, including the ASIA Impairment Scale to classify the severity of spinal cord injuries, Motor and Sensory Scores to assess functional abilities, the Functional Independence Measure (FIM) to determine levels of independence in activities of daily living (ADLs) at admission and discharge, and neuropathic pain symptoms inventory score used to measure the intensity pre and post treatment of neuropathic and phantom limb pain. Patients participated in a multidisciplinary rehabilitation program customized to their individual needs. This program included physical therapy focused on mobility training, strength building, and prosthetic adaptation, carefully adjusted to account for the limitations posed by both SCI and amputation. Pain management followed a multimodal approach, integrating pharmacological treatments, physical modalities, and psychological interventions. Prosthetic fitting and training involved close coordination between the rehabilitation team and prosthetist to ensure optimal fit and functional use. Psychological support, including counseling and social services, addressed emotional challenges and facilitated community reintegration, providing a holistic approach to rehabilitation.

Challenges faced during rehabilitation of these patients

Patients with dual disabilities of spinal cord injury (SCI) and amputation face multifaceted rehabilitation challenges that require a comprehensive and individualized approach. Stump healing and care often pose significant hurdles, with complications such as infections, delayed healing, and sensitivity requiring vigilant management. For instance, Patient 1 needed stump revision for prosthetic fitting, while Patient 5 struggled with chronic osteomyelitis and recurrent ulcers, necessitating extensive wound care. Muscle strength and coordination training were complicated by complete motor loss (LEMS 0) in most cases, demanding innovative mobility exercises tailored to SCI-specific limitations. Mobility training was further hindered by reduced motor control and sensory feedback, particularly in Patients 2 and 4, necessitating upper body strengthening and collaborative prosthetic alignment. Orthotic and prosthetic integration required customization, especially for high-level SCI cases like Patient 3, while Patient 5 benefited from orthotic support to utilize regained residual motor power effectively.

Pain management was a cornerstone of care, with phantom limb pain (Patients 1–4) and neuropathic pain impacting participation in therapy. Multimodal approaches combining medications, mirror therapy, and psychological counseling were employed alongside techniques like TENS to alleviate discomfort. Neurogenic bladder and bowel dysfunction further complicated recovery, necessitating catheterization, bowel training, and dietary adjustments. Recurrent infections, as observed in Patients 4 and 5, demanded close monitoring and antibiotic therapy, while spasticity in cases like Patient 3 required interventions such as muscle relaxants and stretching exercises.

Psychosocial challenges, including depression, anxiety, and body image concerns, were prevalent and addressed through counseling and peer support. Community reintegration was particularly challenging for physically demanding occupations, with vocational training and adaptive strategies aiding their transition. Socioeconomic barriers limited access to advanced rehabilitation resources, emphasizing the importance of cost-effective prosthetics and home-based programs. Long-term follow-up was crucial yet insufficient in cases like Patient 5, leading to complications such as stump infections. Functional independence improvements were gradual but significant, as reflected in low initial FIM scores, such as Patient 3's 4/126 at admission. Progress was greatly aided by instruction in activities of daily living (ADLs), such as dressing, transfers, and personal hygiene. Through a multidisciplinary approach, significant improvements in functional independence and quality of life were achieved in all cases.

Discussions

This case series highlights the multifaceted challenges and outcomes of rehabilitating individuals with dual disabilities of spinal cord injury (SCI) and amputation, underscoring the importance of a multidisciplinary and individualized approach. Consistent with findings by Mustafah et al. [1] and Wang & Hong [3], the combination of paralysis and sensory deficits in SCI complicates prosthetic fitting and mobility training, as observed in Patients 1 and 2, necessitating tailored interventions such as upper limb strengthening and desensitization. Despite stable motor scores, these strategies resulted in significant improvements in functional independence, evidenced by increased FIM scores.

Patients with higher-level SCIs, such as Patient 3, faced compounded challenges including body image concerns and upper limb deficits. The focus on powered mobility and psychological support aligns with strategies described by Ohry et al. [2] and Le & Bui [10], emphasizing the importance of addressing adjustment and mental health challenges to enhance rehabilitation outcomes. The modest FIM score improvements in Patient 3 highlight the need for ongoing psychological and adaptive support.

Patients with lower-level SCI (Patients 4 and 5) demonstrated the potential for targeted motor recovery and vocational reintegration through orthotic support and gait training, consistent with Senthilvelkumar & Chandy's case report [4]. However, recurrent infections in Patient 5 align with the increased complication risk reported by Svircev et al. [8], highlighting the critical role of meticulous wound care and infection management in dual disability rehabilitation.

Pain management emerged as a cornerstone across all cases, reinforcing the efficacy of multimodal approaches combining pharmacologic and psychological strategies as demonstrated by Cherup et al. [7] and DeLisa et al. [9]. Significant reductions in NPSI scores across patients underscore the critical role of pain control in improving quality of life.

Finally, socioeconomic barriers faced by patients in resource-limited settings further complicated their rehabilitation journeys. Yusmido et al. [6] and Le & Bui [10] emphasized that addressing these barriers through cost-effective interventions and psychosocial support is essential to optimize outcomes. This series underscores the need for tailored, resource-sensitive rehabilitation strategies to enhance functional independence and quality of life in individuals with dual disabilities.

Conclusions

In conclusion, the compounded challenges of SCI and amputation require integrated rehabilitation programs tailored to each patient's unique needs. The cases presented in this series underscore the importance of a multidisciplinary approach, combining physical, psychological, and social support to optimize functional independence and quality of life. Future research should focus on refining specific interventions and addressing systemic barriers to care in low-resource environments.

Contributors list

Dr. Sanyal Kumar conceptualized the study, supervised patient management, contributed to data acquisition, analysis, and drafted the manuscript. Dr. Debashish Jena contributed to case evaluation, rehabilitation planning, and critical revision of the manuscript. Dr. Anjani Kumar was

involved in patient care, data collection, and manuscript editing. All authors read and approved the final manuscript and agree to be accountable for all aspects of the work.

Conflicts of Interest

The authors declare that there is no conflict of interest related to this manuscript.

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