e-ISSN: 0976-822X, p-ISSN:2961-6042

Available online on http://www.ijcpr.com/

International Journal of Current Pharmaceutical Review and Research 2026; 18(3); 1967-1973

Original Research Article

Demographic Characteristics and Clinical Phenotype of Neuropathic Pain Following Traumatic Spinal Cord Injury: A Cross-Sectional Study

Mahima Agrawal[1], Astha Patni[2], Nikhil Agarwal[3]

[1]Associate Professor, Department of Physical Medicine & Rehabilitation, Mahatma Gandhi Medical College and Hospital, Jaipur, Rajasthan, India

[2]Associate Professor, Department of Physical Medicine & Rehabilitation, SMS Medical College & Associated Hospital, Jaipur, Rajasthan, India

[3]Assistant Professor, Department of Physical Medicine & Rehabilitation, SMS Medical College & Associated Hospital, Jaipur, Rajasthan, India

Received: 01-12-2025 / Revised: 02-01-2026 / Accepted: 01-02-2026

Corresponding Author: Nikhil Agarwal

Conflict of interest: Nil

Abstract:

Background: Neuropathic pain is a common and disabling complication of traumatic spinal cord injury (SCI), substantially affecting rehabilitation outcomes and quality of life. However, detailed data describing its clinical phenotype in Indian rehabilitation settings remain limited.

Objective: To describe the demographic characteristics, injury profile, and clinical phenotype of neuropathic pain among patients with traumatic SCI attending a tertiary rehabilitation centre.

Methods: This hospital-based cross-sectional study included 147 adults with traumatic SCI and neuropathic pain diagnosed using the Douleur Neuropathique 4 (DN4) questionnaire (score ≥4). Demographic and injury-related variables were recorded, and neuropathic pain characteristics were assessed using the International Spinal Cord Injury Pain Basic Data Set Version 2.0. Descriptive statistics were used to summarize the findings.

Results: The mean age of participants was 33.35 ± 13.35 years, and 92.5% were male. Falls from height (42.9%) and road traffic accidents (42.2%) were the leading causes of injury. Cervical SCI was present in 56.5%, and 76.2% had complete injuries (ASIA Grade A). Neuropathic pain developed within three months in 73.5% of participants and involved multiple anatomical sites in 72.1%. Burning (94.6%), tingling (93.9%), and electric shock-like sensations (83.7%) were the predominant pain descriptors. Most participants reported no diurnal variation (56.5%), no identifiable aggravating factor (32.0%), and no consistent relieving factor (63.9%).

Conclusions: Neuropathic pain following traumatic SCI demonstrates considerable clinical heterogeneity in onset, distribution, symptom characteristics, and modifying factors. Comprehensive phenotypic assessment using standardized tools may facilitate early recognition, individualized management, and optimized multidisciplinary rehabilitation outcomes.

Keywords: Spinal Cord Injuries, Neuralgia, Pain Measurement, Rehabilitation.

DOI: 10.25258/ijcpr.18.3.324

Introduction

Traumatic spinal cord injury (SCI) is a devastating neurological condition that results in permanent motor, sensory, and autonomic dysfunction, leading to substantial physical disability, psychological distress, and socioeconomic burden. Despite advances in acute trauma care and rehabilitation, secondary complications continue to compromise long-term functional recovery and quality of life. Among these, neuropathic pain is one of the most common and disabling complications, affecting approximately 40–70% of individuals following SCI and significantly interfering with mobility, sleep, psychological well-being, social participation, and rehabilitation outcomes. [1-4]

The International Association for the Study of Pain (IASP) defines neuropathic pain as pain arising as a direct consequence of a lesion or disease affecting the somatosensory nervous system. [5] In patients with SCI, neuropathic pain commonly presents as spontaneous burning pain, tingling, electric shock-like sensations, dysesthesia, numbness, and other abnormal sensory experiences resulting from complex neuroplastic changes, central sensitization, and altered pain modulation within the nervous system. [3,4,6] The coexistence of multiple pain descriptors in the same individual reflects the heterogeneous nature of SCI-associated neuropathic pain and presents a considerable challenge in clinical assessment and management.

Accurate characterization of neuropathic pain is essential for guiding individualized treatment and facilitating communication among clinicians and researchers. To standardize pain assessment, the International Spinal Cord Injury Pain Basic Data Set (ISCIPBDS Version 2.0) provides a structured framework for documenting the onset, location, quality, temporal characteristics, and modifying factors of pain in individuals with SCI. [7] Similarly, the Douleur Neuropathique 4 (DN4) questionnaire has been widely validated as a simple and reliable screening tool for identifying neuropathic pain in clinical practice.[8] Standardized assessment enables consistent reporting of pain characteristics and improves the comparability of findings across studies.

Most published studies on SCI-related neuropathic pain have primarily focused on its prevalence, pathophysiological mechanisms, or pharmacological management. [9,10,11] Comparatively fewer studies have comprehensively described the clinical phenotype of neuropathic pain, including its onset after injury, anatomical distribution, pain descriptors, temporal variation, and aggravating or relieving factors, particularly in low- and middle-income countries. A detailed understanding of these clinical characteristics is important because neuropathic pain demonstrates considerable heterogeneity among individuals and may influence treatment selection, rehabilitation planning, and long-term outcomes.

India bears a substantial burden of traumatic SCI, with road traffic accidents and falls from height representing the predominant mechanisms of injury among young adults. [12-14] As the majority of affected individuals belong to the economically productive age group, persistent neuropathic pain contributes significantly to disability, reduced community participation, and increased healthcare utilization. However, data describing the clinical characteristics of SCI-associated neuropathic pain from Indian rehabilitation settings remain limited.

Therefore, the present study was undertaken to describe the demographic profile, injury characteristics, and clinical phenotype of neuropathic pain among patients with traumatic spinal cord injury attending a tertiary rehabilitation centre. A comprehensive characterization of neuropathic pain may improve its recognition in routine clinical practice and support individualized multidisciplinary rehabilitation strategies for this patient population.

Materials and Methods

This hospital-based cross-sectional study was conducted in the Department of Physical Medicine and Rehabilitation, SMS Medical College and Attached Hospitals, Jaipur, India. The study represents a secondary analysis of baseline data obtained from a randomized comparative trial evaluating pharmacological treatment of neuropathic pain following traumatic spinal cord injury.

Study Participants: A total of 147 consecutive adult patients (≥18 years) with traumatic spinal cord injury and neuropathic pain were included. Neuropathic pain was diagnosed using the Douleur Neuropathique 4 (DN4) questionnaire, with a score of ≥4 considered diagnostic.[8] Patients with non-traumatic spinal cord injury, peripheral neuropathy, other neurological disorders causing neuropathic pain, severe cognitive impairment or psychiatric illness that could interfere with pain assessment, serious systemic illness, or those unwilling to provide written informed consent were excluded.

Data Collection: Demographic characteristics (age, sex, family type, marital status, education, and occupation) and injury-related variables (cause of injury, neurological level, ASIA Impairment Scale grade, and operative management) were recorded using a structured case record form. Neurological impairment was classified according to the International Standards for Neurological Classification of Spinal Cord Injury (ISNCSCI) using the American Spinal Injury Association (ASIA) Impairment Scale. [15]

Neuropathic pain was characterized using the International Spinal Cord Injury Pain Basic Data Set Version 2.0, including onset after injury, anatomical distribution, pain descriptors, diurnal variation, and aggravating and relieving factors. [7]

Continuous variables are presented as mean ± standard deviation (SD), while categorical variables are expressed as frequency and percentage.

Ethical Considerations: The study was approved by the Institutional Ethics Committee of SMS Medical College, Jaipur. Written informed consent was obtained from all participants before enrolment, and the study was conducted in accordance with the principles of the Declaration of Helsinki

Results

A total of 147 patients with traumatic spinal cord injury-associated neuropathic pain were included in the study. Their demographic characteristics, injury profile, and clinical characteristics of neuropathic pain are summarized in Tables 1–3.

Demographic Characteristics: The mean age of the study participants was 33.35 ± 13.35 years. More than half of the patients (55.8%) were aged 18–30 years, followed by 18.4% in the 31–40 years age group, 13.6% in the 41–50 years age group, and 12.2% were older than 50 years. The study population was predominantly male (92.5%), with

females constituting 7.5% of the participants.

Regarding sociodemographic characteristics, 53.1% of participants belonged to nuclear families, while 46.9% belonged to joint families. Most participants were married (72.8%). With respect to educational status, 31.3% had completed middle school education, 27.9% were illiterate, 13.6% each had primary and high school education, 10.2% had completed intermediate education, and 3.4% were graduates. Labourers constituted the largest occupational group (29.9%), followed by farmers (23.1%), students (17.7%), individuals engaged in other occupations (22.4%), and drivers (6.8%) **(Table 1).**

Clinical Characteristics of Traumatic Spinal Cord Injury: Falls from height (42.9%) and road traffic accidents (42.2%) were the leading causes of traumatic spinal cord injury. Falls of heavy objects accounted for 9.5% of injuries, while assault (0.7%) and other causes (2.0%) were relatively uncommon. Data regarding the cause of injury were unavailable for four participants (2.7%).

The neurological level of injury was cervical in 83 (56.5%) patients and dorsolumbar in 64 (43.5%) patients. According to the American Spinal Injury Association (ASIA) Impairment Scale, 112 (76.2%) participants had complete spinal cord injury (Grade A), whereas 16 (10.9%), 10 (6.8%), and 9 (6.1%) patients were classified as Grades B, C, and D, respectively. The majority of patients (81.6%) were managed conservatively, while 18.4% underwent operative management **(Table 2).**

Clinical Profile of Neuropathic Pain: Neuropathic pain developed within 3 months of traumatic spinal cord injury in 108 (73.5%) patients, whereas 39 (26.5%) developed pain after 3 months. Pain most frequently involved multiple anatomical sites (72.1%), while 27.9% of patients reported pain confined to the lower limbs.

Burning pain was the most frequently reported neuropathic pain descriptor, being present in 94.6% of patients, followed by tingling (93.9%) and electric shock-like sensations (83.7%). Heaviness (6.1%) and numbness (1.4%) were reported less frequently. As multiple pain descriptors could be experienced simultaneously, the cumulative percentage exceeded 100%.

Regarding temporal variation, more than half of the participants (56.5%) reported no diurnal variation in pain intensity. Pain was more severe during the night in 32.6% of patients and during the daytime in 10.9%.

Nearly one-third of the participants (32.0%) reported no identifiable aggravating factor. Among those reporting identifiable triggers, physical activity (24.5%) was the most common aggravating factor, followed by bladder/bowel-related activities (9.5%) and environmental factors (4.1%). The remaining 29.9% reported other aggravating factors.

Most participants (63.9%) reported no specific relieving factor. Among those with identifiable relieving factors, physical measures (23.8%), including modalities such as massage and cold sponging, were the most commonly reported, followed by position change (4.8%). Other relieving factors were reported by 7.5% of patients **(Table 3)**

Table 1: Demographic Characteristics of the Study Population

Age Group	18–30	82(55.8%)
	31–40	27(18.4%)
	41–50	20(13.6%)
	>50	18(12.2%)
Sex	Male	136(92.5%)
	Female	11(7.5%)
Family type	Nuclear	78(53.1%)
	Joint	69(46.9%)
Marital status	Married	107(72.8%)
	Unmarried	40(27.2%)
Education	Illiterate	41(27.9%)
	Primary	20(13.6%)
	Middle School	46(31.3%)
	High School	20(13.6%)
	Intermediate	15(10.2%)
	Graduate	5(3.4%)
Occupation	Labourer	44(29.9%)
	Farmer	34(23.1%)
	Student	26(17.7%)
	Driver	10(6.8%)
	Others	33(22.4)

Table 2: Clinical Characteristics of Traumatic Spinal Cord Injury

Cause of injury	Road traffic accident	62(42.2%)
	Fall from height*	63(42.9%)
	Fall of heavy weight	14(9.5%)
	Assault	1(0.7%)
	Miscellaneous	3(2%)
	Missing	4(2.7%)
Neurological level	Cervical	83(56.46%)
	Dorso Lumbar	64(43.54%)
ASIA Impairment Scale	Grade A	112(76.2%)
	Grade B	16(10.9%)
	Grade C	10(6.8%)
	Grade D	9(6.1%)
Operative management	Operated	27(18.4%)
	Conservatively managed	120(81.6%)

Table 3. Clinical Profile of Neuropathic Pain

Onset of pain after Trauma	< 3month	108(73.47%)
	> 3month	39(26.53%)
Site of pain	Lower limb only	41(27.90%)
	Multiple sites	106(72.10%)
Pain Descriptor	Burning	139(94.6%)
	Electric shock-like	123(83.7%)
	Tingling	138(93.9%)
	Numbness	2(1.4%)
	Heaviness	9(6.1%)
Diurnal variation	No variation	83(56.5%)
	More during daytime	16(10.9%)
	More during night	48(32.6%)
Aggravating factors	None identified	47 (32.0)
	Physical activity	36 (24.5)
	Bladder/Bowel-related	14 (9.5)
	Environmental factors	6 (4.1)
	Others	44 (29.9)
Relieving factors	None identified	94 (63.9)
	Physical measures	35 (23.8)
	Position change	7 (4.8)
	Others	11 (7.5)

Discussion

Neuropathic pain is among the most disabling long-term complications of traumatic spinal cord injury (SCI), adversely affecting rehabilitation and quality of life. The present study provides a comprehensive description of the demographic characteristics, injury profile, and clinical phenotype of neuropathic pain among patients with traumatic spinal cord injury attending a tertiary rehabilitation centre. The findings demonstrate that neuropathic pain following SCI is clinically heterogeneous with respect to its onset, anatomical distribution, sensory descriptors, temporal characteristics, and symptom-modifying factors. These observations emphasize the importance of systematic phenotypic assessment to facilitate individualized rehabilitation and optimize pain management. [1-4]

The mean age of the study population was 33.35 ± 13.35 years, with more than half of the participants belonging to the 18–30-year age group. This finding is consistent with previous epidemiological studies demonstrating that traumatic SCI predominantly affects young adults during their economically productive years. [12-14] Younger individuals are more frequently exposed to high-energy trauma related to occupational activities, road traffic accidents, and falls from height. Consequently, the burden of chronic neuropathic pain extends beyond physical disability and has important socioeconomic implications by reducing employment opportunities, productivity, and community participation.

The marked male predominance (92.5%) observed in the present study is comparable with reports from India and other countries, where males

account for the majority of traumatic SCI cases. [12-14] This gender disparity has largely been attributed to greater occupational exposure to physically demanding work, outdoor activities, and motor vehicle use. The predominance of male patients in rehabilitation clinics further reflects the epidemiology of traumatic SCI in developing countries.

Most participants belonged to nuclear families (53.1%) and were married (72.8%). Although these variables were not evaluated as determinants of pain severity or functional outcome, they provide important socioeconomic context. Family support has been reported to influence rehabilitation adherence, psychological adjustment, and long-term community reintegration following SCI. Future studies should evaluate the relationship between family structure, caregiver support, and pain-related disability in this population.

Regarding educational status, approximately one-third of participants had completed middle school education, while nearly one-third were illiterate. Labourers and farmers together constituted more than half of the study population. These findings reflect the occupational and socioeconomic profile of patients attending public tertiary-care rehabilitation services in India. Individuals engaged in manual labour are more likely to sustain traumatic SCI because of occupational hazards, falls from height, and inadequate workplace safety measures. Similar demographic patterns have been reported in previous Indian epidemiological studies. [12-14]

Falls from height (42.9%) and road traffic accidents (42.2%) were the leading mechanisms of injury in the present study. These findings are comparable with previous reports from India, where falls from rooftops, trees, construction sites, and agricultural settings remain major causes of traumatic SCI, while road traffic accidents continue to contribute substantially to the injury burden. [12-14] In contrast, studies from several high-income countries have demonstrated a relatively higher contribution of motor vehicle collisions and sports-related injuries. Differences in occupational practices, environmental conditions, and safety regulations may explain these variations.

More than half of the participants sustained cervical spinal cord injuries (56.5%), while 76.2% had complete neurological injuries (ASIA Grade A). The predominance of cervical injuries is similar to findings reported by hospital-based rehabilitation cohorts and may reflect referral patterns, as patients with cervical SCI frequently require prolonged multidisciplinary rehabilitation because of greater neurological impairment. The high proportion of complete injuries further indicates that many patients presented with severe neurological deficits, which may increase the likelihood of developing persistent neuropathic pain. [3,6]

The majority of participants (81.6%) were managed conservatively, whereas only 18.4% underwent surgical intervention. This distribution probably reflects delayed referral to rehabilitation centres after completion of acute management, financial constraints, variability in injury characteristics, and differences in surgical indications. Because the present study focused on baseline clinical characteristics rather than treatment outcomes, the influence of operative management on neuropathic pain could not be evaluated.

Approximately three-fourths (73.5%) of patients developed neuropathic pain within the first three months following traumatic SCI. Early onset of neuropathic pain has been consistently reported in longitudinal studies and is believed to result from rapid neuroplastic changes within the injured spinal cord and supraspinal pain-processing pathways. [1,3] Recognition of this early temporal pattern is clinically important because prompt identification and initiation of appropriate pharmacological and rehabilitation interventions may reduce the progression of chronic pain and improve functional outcomes.

A notable finding of the present study was that 72.1% of patients experienced neuropathic pain involving multiple anatomical sites, whereas only 27.9% reported pain confined to the lower limbs. Multisite pain has previously been described in patients with SCI and may reflect widespread alterations in central pain processing following injury. [9,16] The presence of pain at multiple sites may increase the overall burden of symptoms and complicate clinical management, emphasizing the importance of documenting pain distribution during routine rehabilitation assessment.

Burning (94.6%), tingling (93.9%), and electric shock-like sensations (83.7%) were the predominant pain descriptors in the present study. These findings closely resemble those reported by Widerström-Noga and colleagues, Siddall et al., and Finnerup et al., who described burning pain as the characteristic manifestation of central neuropathic pain following SCI. [3,11,16,17] The coexistence of multiple sensory descriptors in the majority of patients further supports the concept that SCI-related neuropathic pain is multidimensional rather than a single clinical entity. Consequently, comprehensive assessment using standardized pain questionnaires is essential for accurate diagnosis and individualized treatment planning.

More than half of the participants (56.5%) reported no diurnal variation in pain intensity, whereas approximately one-third experienced greater pain

during the night. Although relatively few studies have specifically examined diurnal variation in SCI-related neuropathic pain, nocturnal exacerbation may be associated with reduced environmental distractions, sleep disturbances, altered central pain modulation, and prolonged immobility. [17] Further longitudinal studies are required to clarify the clinical significance of temporal fluctuations in neuropathic pain and their relationship with sleep quality and psychological health.

Nearly one-third of patients reported no identifiable aggravating factor, while physical activity represented the most common trigger among those with identifiable aggravating factors. Bladder and bowel-related activities and environmental factors were less frequently reported. Physical activity may exacerbate neuropathic pain through mechanical stress, muscle spasm, increased afferent input, or altered postural loading during transfers and mobility. Identification of activity-related pain is particularly relevant in rehabilitation practice because individualized exercise prescription and activity modification may improve treatment adherence while minimizing symptom exacerbation.

Similarly, 63.9% of participants reported no consistent relieving factor, whereas physical measures, including massage, stretching, and cold sponging, represented the most commonly reported non-pharmacological approaches among those experiencing symptom relief. These observations emphasize the chronic and persistent nature of SCI-associated neuropathic pain and highlight the need for multimodal management combining pharmacological therapy with physical rehabilitation, patient education, and psychological interventions. Current clinical guidelines recommend an individualized multidisciplinary approach because complete pain relief is rarely achieved with pharmacological treatment alone. [10,11]

The present study has several strengths. It provides a comprehensive phenotypic description of neuropathic pain using standardized clinical assessment in a relatively large cohort of patients with traumatic SCI. Furthermore, the study contributes valuable data from an Indian tertiary rehabilitation centre, where published evidence describing the clinical characteristics of SCI-associated neuropathic pain remains limited.

However, certain limitations should be acknowledged. The cross-sectional, single-centre design limits causal inference and generalizability. The analysis was restricted to baseline clinical data and did not evaluate pain intensity, functional outcomes, psychological factors, or quality of life. Longitudinal multicentre studies are needed to validate these findings.

Overall, the present findings reinforce that neuropathic pain after traumatic SCI is a multidimensional clinical entity characterized by diverse sensory descriptors, variable anatomical distribution, and heterogeneous symptom-modifying factors. Comprehensive phenotypic assessment should therefore be incorporated into routine rehabilitation practice to facilitate early diagnosis, individualized treatment planning, and improved long-term outcomes.

Bibliography

1. Siddall PJ, McClelland JM, Rutkowski SB, Cousins MJ. A longitudinal study of the prevalence and characteristics of pain in the first 5 years following spinal cord injury. Pain. 2003;103(3):249–257.
2. Jensen MP, Hoffman AJ, Cardenas DD. Chronic pain in individuals with spinal cord injury: a survey and longitudinal study. Spinal Cord. 2005;43(12):704–712.
3. Finnerup NB, Baastrup C. Spinal cord injury pain: mechanisms and management. Curr Pain Headache Rep. 2012;16(3):207–216.
4. Colloca L, Ludman T, Bouhassira D, Baron R, Dickenson AH, Yarnitsky D, et al. Neuropathic pain. Nat Rev Dis Primers. 2017;3:17002.
5. Jensen TS, Baron R, Haanpää M, Kalso E, Loeser JD, Rice ASC, et al. A new definition of neuropathic pain. Pain. 2011;152(10):2204–2205.
6. Finnerup NB, Haroutounian S, Kamerman P, Baron R, Bennett DLH, Bouhassira D, et al. Neuropathic pain: an updated grading system for research and clinical practice. Neurology. 2016;87(2):220–228.
7. Widerström-Noga E, Biering-Sørensen F, Bryce TN, Cardenas DD, Finnerup NB, Jensen MP, et al. International Spinal Cord Injury Pain Basic Data Set Version 2.0. Spinal Cord. 2014;52(4):282–286.
8. Bouhassira D, Attal N, Alchaar H, Boureau F, Brochet B, Bruxelle J, et al. Comparison of pain syndromes associated with nervous or somatic lesions and development of a new neuropathic pain diagnostic questionnaire (DN4). Pain. 2005;114(1–2):29–36.
9. Widerström-Noga E, Felix ER. Multidimensional assessment of neuropathic pain after spinal cord injury. J Rehabil Res Dev. 2014;51(1):1–12.
10. Cardenas DD, Bryce TN, Shem K, Richards JS, Elhefni H. Management of neuropathic pain associated with spinal cord injury. Curr Phys Med Rehabil Rep. 2013;1(3):194–203.
11. Siddall PJ, Middleton JW. A proposed algorithm for the management of pain following spinal cord injury. Spinal Cord.

2015;53(1):14–18.
12. Singh R, Sharma SC, Mittal R, Sharma A. Traumatic spinal cord injuries in Haryana: an epidemiological study. Indian J Community Med. 2003;28:184–186.
13. Ning GZ, Wu Q, Li YL, Feng SQ. Epidemiology of traumatic spinal cord injury worldwide: a systematic review. Spine (Phila Pa 1976). 2012;37(8):709–716.
14. Kumar R, Lim J, Mekary RA, Rattani A, Dewan MC, Sharif SY, et al. Traumatic spinal injury: global epidemiology and worldwide volume. World Neurosurg. 2018;113:e345–e363.
15. Kirshblum SC, Burns SP, Biering-Sørensen F, Donovan W, Graves DE, Jha A, et al. International standards for neurological classification of spinal cord injury (Revised 2011). J Spinal Cord Med. 2011;34(6):535–546.
16. Rosner J, Curt A, Hubli M. Neuropathic pain after spinal cord injury: clinical phenotyping and implications for treatment. Eur J Pain. 2022;26(10):2162–2175.
17. Widerström-Noga E. Neuropathic pain after spinal cord injury: clinical characteristics and therapeutic perspectives. Continuum (Minneap Minn). 2022;28(4):1108–1128.