

# Prevalence of Upper Limb Neuropathy in Rehabilitated Spinal Cord Injured Patients in North India.

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## ABSTRACT

**Background:** Upper extremities are principally adapted for grasping or seizing activities. In individuals with spinal cord injury, they are additionally used for transfers, wheelchair propulsion, and daily living activities, putting additional strain on the joints. For this reason, it is essential to distinguish the effects of these increased demands in terms of prevalence of peripheral neuropathies in rehabilitated spinal cord injured population from developing countries. **Methods:** Spinal cord injury patient with a neurological level below T2, who were independent in activities of daily living was monitored during the yearly follow up. Electrodiagnostic study of median, ulnar, radial nerve was graded in a scale of 0-2 with 0 being normal, 1 being neuropathy of one hand and 2 being an association of both the hands and the final conclusion was based on this study. **Results:** There were 45 wheelchair users, 5 walker users, 30 elbow crutch users, 10 subjects using sticks and one subject with a unilateral transtibial amputation using an axillary crutches. Thirty eight patients were using tricycle for independent mobility. Among 55 patients using wheel chair CTS was observed in 70% patients. In the same group 24% had ulnar neuropathy and 16% had radial neuropathy. **Conclusion:** Findings of our study suggest that upper limb compressive neuropathy was highly prevalent among the spinal cord injury patients. Further, current study recorded carpal tunnel syndrome was the most common neuropathy incorporated with paraplegia patients especially using wheel chair and crutches. We strongly advocate for the importance of the modification of in the vocational instruments like light weight or electrical wheelchair etc along with improvement in accessories like grip style, gloves etc to avoid the constant pressure and repetitive trauma to upper limb of paraplegia patients with spinal cord injury.

**Keywords:** Spinal cord injury, Prevalence, carpal tunnel syndrome, Mobility aids.

## INTRODUCTION

Upper extremities are principally adapted for grasping or seizing activities. Because the Upper extremities of the spinal cord injury patient are also needed for daily functions such as mobility they are used more frequently and strenuously and subject to increased stresses compared to those of an able-bodied individual. In individuals with spinal cord injury, they are additionally used for transfers, wheelchair propulsion, and daily living activities, putting additional strain on the joints. The collective effects of recurring loading forces can lead in joint degeneration and neuropathies.<sup>[1]</sup> In view of the fact

that the primary injury itself cause many changes in lifestyle and limit independence, further quality of life can worsen by complications such as peripheral nerve entrapments in these individuals.<sup>[2]</sup> In a developing country like India, independence in mobility is further limited by architectural barriers, disabled unfriendly public transport and socio-cultural barriers. This leads to greater strain on the upper extremities compared to their western counterparts

In the western population, the occurrence of upper extremity compressive nerve entrapments particularly carpal tunnel syndrome in chronic spinal injured persons have been shown to range from six point four percent to sixty-seven percent. In disabled patient cohorts ulnar nerve damage has also been reported.<sup>[5-7]</sup> These injuries can have major consequences, as individuals with lower extremity limitation may be partly or fully dependent on their upper limbs for mobility, actions of daily living, and employment. Treatment of patients with upper

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extremity entrapment neuropathies overlays on a pre-existing disability poses special problems. Upper limb pain harmfully affects functional status and quality of life in patients with long-term poliomyelitis.<sup>[8]</sup> While the primary injury itself limits the patient's independence, further functional limitation due to secondary complications, such as peripheral nerve entrapments, can markedly worsen the patient's quality of life. Literature shows that the two most common peripheral nerve abnormalities (median neuropathy at the wrist and ulnar neuropathy at the elbow) are related to repetitive use like propelling the wheelchair, push-ups and transfers.<sup>[4,6]</sup>

For this reason, it is essential to distinguish the effects of these increased demands in terms of prevalence of peripheral neuropathies in rehabilitated spinal cord injured population from developing countries.

## MATERIALS AND METHODS

Spinal cord Injury patient with a neurological level below T2, who were independent in activities of daily living was monitored during the yearly follow up visit.

### Exclusion Criteria

Patients with, head injury, known brachial plexopathy, neck pain, connective tissue disorders, and tetraplegics were excluded from the study.

General physical examination and assessment of medical symptoms were done of all the subjects who were recruited for the study. The baseline demographic parameters were documented such as time ever since the injury, age, sex, American Spinal Injury Association (AIS) scale, profession, comorbidities and present approach of indoor and outdoor mobility.

The electrodiagnostic studies including nerve conduction studies of both sensory and motor median, ulnar and radial nerves were carried out bilaterally.

The standard protocol put forth by the American Association of Electrodiagnostic Medicine<sup>7,8</sup> was followed. Medelec Synergy machine was used for the study. The distal latency, conduction velocity across wrist and amplitude was recorded and examined to diagnose neuropathy if any, in studied nerve.

Electrodiagnostic Protocol for Diagnosis of Median, Ulnar and Radial Neuropathy,<sup>[6,7]</sup>

### Diagnostic criteria for median neuropathy at wrist

- A distal latency in motor component of more than 4.4 ms or a distal latency in sensory component of more than 3.4 ms were considered as positive for CTS

- Difference between the distal motor latency of the median and ulnar nerves >1.1 ms
- Difference between the distal sensory latency of the median and ulnar nerves > 0.2 ms
- Difference between median and ulnar sensory latency on 4th digit stimulation and recording from the wrist at an equal distance is >0.4 ms and
- Difference between median and radial sensory latency on thumb stimulation and recording from the wrist at an equal distance is >0.4 ms
- Palm wrist conduction: the difference between median and ulnar sensory latency across 8cm >0.4ms

### Diagnostic criteria for ulnar neuropathy at the wrist

- Prolonged wrist to ADM distal motor latency greater than 3.4 ms
- Prolonged wrist to FDI latency greater than 4.5 ms

### Diagnostic criteria for the radial superficial sensory branch involvement

- Amplitude more than 20.5  $\mu$ V or/and conduction velocity more than 64m/s.

Electrodiagnostic study of median, ulnar, radial nerve was graded in a scale of 0-2 with 0 being normal, 1 being neuropathy of one hand and 2 being an association of both the hands and the final conclusion was based on this study.

The scores from demographic data and electrodiagnostic data were accessed and intergroup comparison were made in order to find the prevalence of upper limb neuropathy amongst users with various mobility aids.

Statistical Analysis:

Data were analyzed using the SPSS 17.0 for Windows. The following variables were evaluated as potential risk factors for peripheral compressive neuropathies- vocation, time since injury, use of walker/crutches/wheelchairs/tricycle. Chi- square test for independence and Fisher's exact test was used as a test of statistical significance to analyze categorical variables. P-value<0.05 was considered as statistically significant.

## RESULTS

Out of 270 patients 100 patients fulfilling the inclusion criteria were included in the study those were rehabilitated in our institute previously. Among study patients Eighty two patients were male while eighteen patients were female. Demographic data presented in [Table 1] shows that mean age and mean weight of total patients were  $40 \pm 8.9$  years and  $56.8 \pm 9.6$  Kg.

[Table 2] shows that median age of injury was 9 years ranging from 1 year to 25 years. Further, [Table 2] shows that there most of the patients (25%) belong to 5 to 10 years injury group. Minimum

number of patients (6%) had less than 1 year of injury time. However, there was an insignificance relation between time period and median (>0.05), ulnar (>0.05) or radial (>0.05) neuropathy.

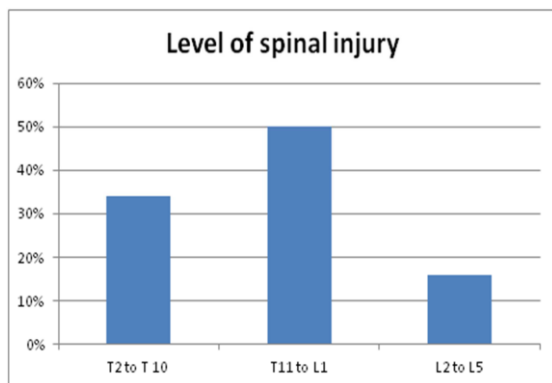
**Table 1: Demographic data of the study population.**

Variants	Total Patients (n= 100)	Male Patients (n= 82)	Female patients (n= 18)
Number of patients in percentage (%)	100%	82%	18%
Age (Years)	40±8.9	39.8±7.8	41.2±9
Weight (Kg)	56.8±9.6	57.2±8.9	55.6±10.1

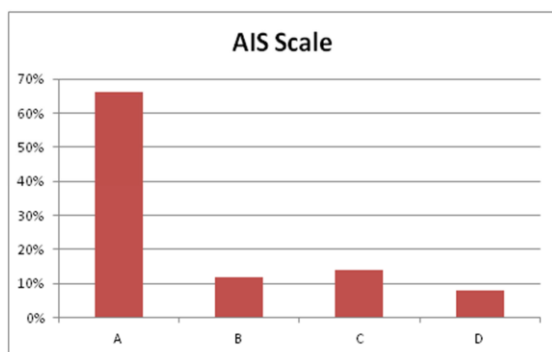
**Table 2: Distribution of patients according to time period of injury.**

Duration of injury (Years)	Number of patients	Percentage of patients
Median range of total patients (9 years)	100	100%
≤ 1 years	6	6 %
1 to 5 years	22	22 %
5 to 10 years	25	25 %
10 to 20 years	25	25 %
> 20 years	22	22 %

It is evident from [Figure 1] that thirty four, fifty and sixteen patients were suffering from injury of T2-T10, T11 to L1 and L2 to L5 category correspondingly.



**Figure 1: Distribution of patients according to level of spinal injury**



**Figure 2: Distribution of patients according to AIS scale**

Results of the current study showed that maximum patients (66) had AIS A paraplegia followed by ASA B, C, D in twelve, fourteen and eight patients respectively. [Figure 2]

[Table 3] shows that majority of male patients belong self employed group (32%) followed by tailor, professional, teacher, unemployed and student.

**Table 3: Distribution of male patients according to occupation.**

Occupation	Number of Patients	Percentage
Businessman	32	32%
Farming	6	6%
Tailor	14	14%
Professional	8	8%
Watchman	2	2%
Student	4	4%
Teacher	8	8%
Unemployed	8	8%

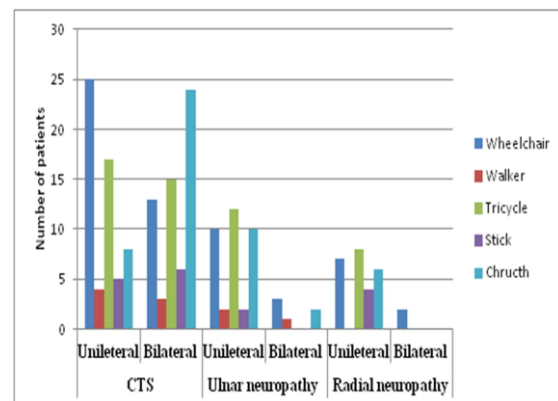
On the other hand majority of female patients belong to household group followed by business women. [Table 4]

**Table 4: Distribution of female patients according to occupation**

Occupation	Number of Patients	Percentage
House hold	10	55.5%
Tailor	2	11%
Teacher	2	11%
Business women	4	22.5%

It is evident from figure 3 that there 55 patients using wheelchair out of 100 as mobility aid. There were 45 wheelchair users, 5 walker users, 30 elbow crutch users, 10 subjects using sticks and one subject with a unilateral transtibial amputation using an axillary crutches. Thirty eight patients were using tricycle for independent mobility. Among 55 patients using wheel chair CTS was observed in 70% patients. In the same group 24% had ulnar neuropathy and 16% had radial neuropathy.

The overall prevalence of CTS among the 100 subjects included in this study were 70 subjects with 20 unilateral and 50 bilateral cases, ulnar neuropathy was 20% and 18% had radial neuropathy. [Figure 3]



**Figure 3: Distribution of study population according to various mobility add and Neurological disorders**

## DISCUSSION

Results of the present study recoded an insignificant difference in basic parameters like age and weight of male and female study population. Various mobility aids are used by patients of paraplegia as they transfer their weight on upper limbs for mobility.<sup>[6]</sup> Due to awareness of paralysis, better health care and facilities now a day spinal cord injury patients have a far better expectancy for life comparison of few years back.<sup>[9]</sup> However, this increase of life span of such patients induces secondary complications to upper limb due to excessive use.<sup>[10]</sup> Carpal tunnel syndrome, ulnar and radial neuropathies are the commonest anomalies produced by excessive pressure implicated on cubital tunnel and carpal tunnel during the movement by such patients.<sup>[6,11]</sup> These deformities are more common in developing countries like India as transportation is not disabled friendly therefore, upper limbs are more prone to various injuries due to excessive dependency for mobility which may lead compromise to their mobility in future.

Present study recorded that there was 10, 2 and 12 patients were suffering with ulnar neuropathy respectively wheel chair, walker and tricycle users. These findings are consistent with the earlier study of Burnham et al on athletics with spinal injury. Burnham et al reported more than 19% incidence of ulna neuropathy in their study on athletes on wheel chair. They suggested injury of ulnar nerve might occurred in these patients due to continuous contraction of flexor carpi ulnaris muscles which in turn injure the ulnar nerve and entrapped it.<sup>[9,11]</sup> An another possible mechanism they reported that prolonged rest of forearm on wheel chair as well increase movement of flexion and extension leads to enhanced movement of cubital tunnel might cause ulnar neuropathy.

Carpale tunnel syndrome is one of the commonest disorders found even in normal subjects without any spinal injury.<sup>[12]</sup> Results of the current study showed that CTS was most common anomaly which found in major portion of the study population. These findings are in agreement with the earlier study of Gellman et al,<sup>[6]</sup> recorded high incidences of CTS in patients suffering with paraplegia compare to subjects without paraplegia. They justified their results by suggesting that pressure exerted on the wrist while propelling the wheel chair was the root cause for the CTS in their study population.

Similarly, various studies have shown that CTS was more commonly prevalent up to 60% among patients with paraplegia.<sup>[3,4]</sup> Moreover, studies suggest that prevalence of these neuropathies might be still higher by electrodiagnosis compare to self reported.<sup>[12,13]</sup> Alike Burnham et al,<sup>[11]</sup> and Yang et al,<sup>[14]</sup> recorded increased incidence of CTS in paraplegia patients. This high incidence of CTS in paraplegia patients would be due to degenerative

process induce be flexion and extension movement of wrist which further increase to pressure of intracarpal canal.<sup>[6,13]</sup>

Results of our study showed that incidence CST was also high in crutch users. Moreover, median neuropathy was predominantly at wrist site in this study.

This median neuropathy in these SCI patients may be due to repeated pressure on wrist via continuous hyperextension of wrist during use of various mobility aids.<sup>[14]</sup>

Majority of patients unable to peruse their profession of prior to SCI. Vocational training an essential part of rehabilitation is mostly job oriented which have less transport requirements for such type of patients. Findings of the present study showed that most of the patients adopted business followed by tailoring as profession for earning.

Nonetheless, there was an insignificant difference between subjects pursuing sedentary job against those doing heavy work but there was a definitely higher involvement of the median nerve.

There was no significant relation between time periods of injury more than 10 years. These findings are consistent with the previous study of Stefaniwsky et al.<sup>[15]</sup> In the developing country like India there are lots of architectural as well as social difficulties for transportation of such type of patients.

Therefore, they required more than two mobility aids to maintain their mobility.

Results of the current study showed that median and ulnar neuropathy were less common in crutch users. There was an insignificant difference in the patients with these neuropathic incidences compare to single mobility aid users. However, findings of the present study strongly indicate towards the risk of development of median nerve compression and ulnar nerve injury the wrist due to constant pressure and over use of upper limbs. There were 4 crutch users out of 6 radial neuropathy patients. This high prevalence of radial neuropathy in crutch user may be due to repeated trauma on radial nerve due to excessive use of extremities during walking with church. In addition radial nerve is more prone to injury in church users due to chronic pressure as the branch of radial nerve becomes subcutaneous at this site.

## CONCLUSION

Findings of our study suggest that upper limb compressive neuropathy was highly prevalent among the spinal cord injury patients. However, there was an insignificant relation between upper limb compressive neuropathy and spinal cord injury in the current study. This might be due to smaller number of the paraplegia patients in our study. Further, current study recorded carpal tunnel syndrome was the most common neuropathy

incorporated with paraplegia patients especially using wheel chair and crutches. However, any significant relation between prevalent neuropathy with time period of injury or types and time of particular vocation use was not recorded. Nevertheless we strongly advocate for the importance of the modification of in the vocational instruments like light weight or electrical wheelchair etc along with improvement in accessories like grip style, gloves etc to avoid the constant pressure and repetitive trauma to upper limb of paraplegia patients with spinal cord injury.

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