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Determination Of Functional Prognostic Indicators And Rehabilitation Potential In Traumatic Spinal Cord Injury Versus Non-Traumatic Myelopathy.

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ABSTRACT

Spinal cord Injuries (SCI) are associated with significant functional impairment in the areas of mobility, Activities of Daily living, bowel and bladder function, and sexuality. They can be of Traumatic or Non traumatic etiology and non-traumatic myelopathies in turn can be due to compressive or non-compressive etiologies. Traumatic SCL occurs primarily in young adults with more than half being between 16 to 30 years of age while the presenting age of Non traumatic myelopathy varies depending upon the etiology. Due to varied demographic features, varying duration of symptom onset, varying clinical presentation depending on the etiology and associated complication profile that are quite different for Non-traumatic traumatic etiology, it is difficult to predict the outcome despite the medical or surgical management. So, it is essential to study the predictors of functional outcome and rehabilitation potential, to set realistic goals and to plan individualized effective rehabilitation.

Keywords: Spinal cord injury, Neurologic recovery, Prognosis of recovery, Outcome Predictors, FIM (Functional Independent Measure), ASIA, LOS (Length of Stay).

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INTRODUCTION

Spinal cord injury (SCI) has devastating consequences for the physical, social, and vocational well-being of patients.[1] The demographic of SCIs is shifting such that an increasing proportion of older individuals are being affected. Pathophysiological, the initial mechanical trauma (the primary injury) permeabilizes neurons and glia and initiates a secondary injury cascade that leads to progressive cell death and spinal cord damage over the subsequent weeks. Over time, the lesion remodels and is composed of cystic cavitation and a glial scar, both of which potently inhibit regeneration [2]. NTSCI causes are very variable and heterogeneous, and recent international guidelines have been developed to classify them systematically [3]. Axis 1 in this nomenclature is to distinguish those NTSCI that are congenital (i.e., spinal dysraphism, Chiari malformations, and skeletal malformations) or genetic disorders (hereditary spastic paraparesis, spinocerebellar ataxias, adreno-myeloneuropathy, leukodystrophies, and spinal muscular atrophy), as opposed to those that are acquired (vertebral column degenerative disorders, metabolic disorders, vascular disorders, inflammatory/autoimmune diseases, radiation-related, toxic, neoplastic, infectious, and miscellaneous) [4]. Acquired NTSCI is usually associated with older age individuals, with degenerative spinal column conditions being the most common causes. Other common acquired conditions include benign or malignant tumors, vascular problems, and infectious or inflammatory processes [5].

METHODOLOGY

This non-concurrent cohort study, both retrospective and prospective was conducted in the year between 2019-2022 at GMKMC a tertiary care referral hospital. Individuals with traumatic & non-traumatic spinal cord compromise with age above 5 years of both sex and primarily treated either medically or surgically were included for the study with informed consent. Among the study population of 1221 individuals with SCI, the study cohorts of Traumatic and Non traumatic etiology included age, sex and ASIA matched participants in the ratio of T: NT is 3:1 (84:28). Detailed history taking included symptom onset, progression, etiological confirmation and treatment history through patient's & care giver's interviews and review of medicals records.

Initial clinical assessment was focused at determining the presenting neurological level and identifying comorbidities and complications if any and included psychological assessment. Recovery pattern was studied and documented with periodical assessment during conventional inpatient rehabilitation and periodically after discharge. All the subjects were followed up till 6 months from hospital admission irrespective of time of onset of symptoms or length of stay in hospital. With detailed analysis of various factors, potential outcome predictors were identified in both the cohorts and analysed.

Exclusion Criteria: Supra-spinal involvement, Multisystem involvement.

Outcome measures used: FIM Score, FIM efficiency, SCIM III, VAS, MAS, AMI.

RESULTS AND DISCUSSION

The mean age of presentation in Traumatic SCI is 32 whereas it is 53 in non-traumatic myelopathy. In our study population, despite more common presentation of both Traumatic SCI and Non-Traumatic myelopathy in males, Traumatic etiology outnumbered Non traumatic etiology in male preponderance. Participants of both the subsets were from low socioeconomic status. Comorbidities like Diabetes Mellitus, Hypertension and hyperlipidemia were more common among non-traumatic subgroups.

DOS for rehabilitation was higher for the traumatic group as compared to the non-traumatic group (65.97±47.66 vs 60.68±45.69 days), although statistically not significant (P>0.05).

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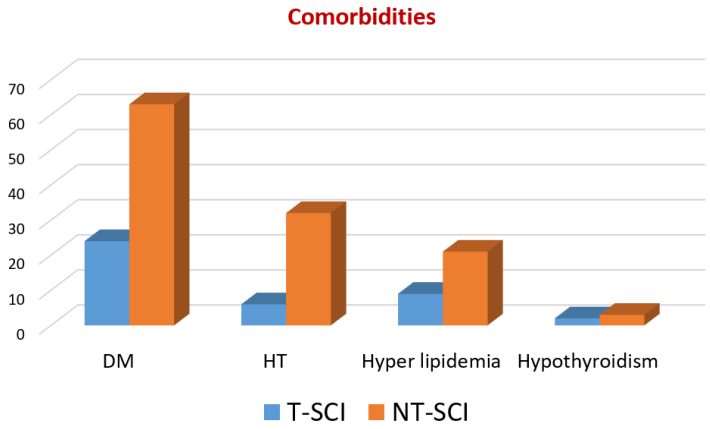
Table 1: General Demography.

Feature	Traumatic	Non-traumatic
Mean Age	32	53
Gender: M (%)	>99	59
F (%)	<1	41
Socio Economic Status	Low	Low

Graph 1: Comorbidities

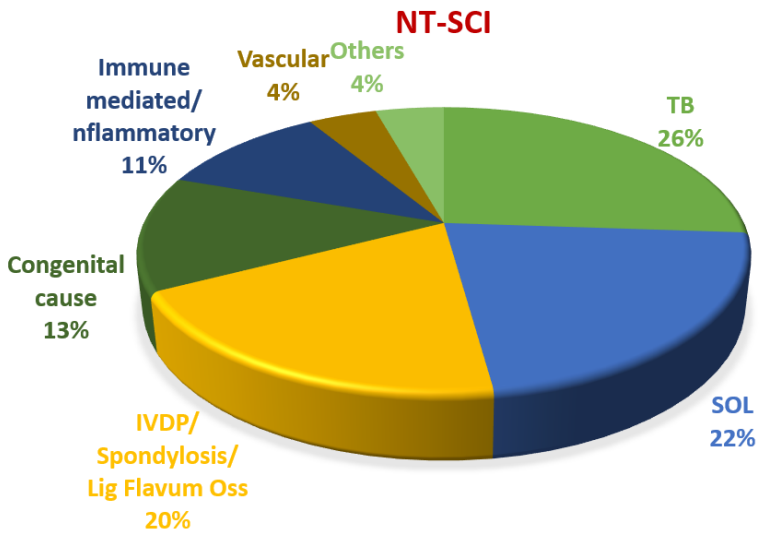


Most common mode of Injury among traumatic SCI was fall from height (56%) and RTA accounted for 33% of T – SCI.

Most common cause of non-traumatic myelopathy in this study setting was tuberculous origin followed by SOL and Spondylosis/IVDP with secondary canal stenosis.

26% of NTM in this study was due to Potts Spine. SOL and age related degeneration of spine accounted for approximately 22% and 20% respectively. This finding is in contrary to other studies conducted in western world where SOL or degenerative causes were the leading ones. In this study tuberculous etiology out-weighed others as incidence and prevalence of tuberculosis is much higher in India so as with Potts spine as well and also contributed to subset of NTM with treatable cause. Drug resistance and toxicities has to be addressed and duration of multi drug treatment has to be individualized depending on the compliance and response to treatment. Possibilities of skip lesions have to be considered while goal settings and rehab planning.

Graph 2: Etiology.



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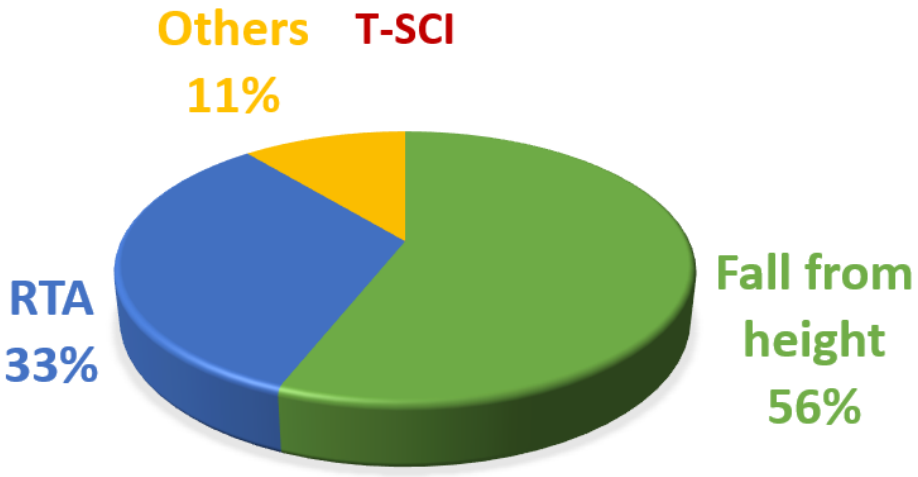
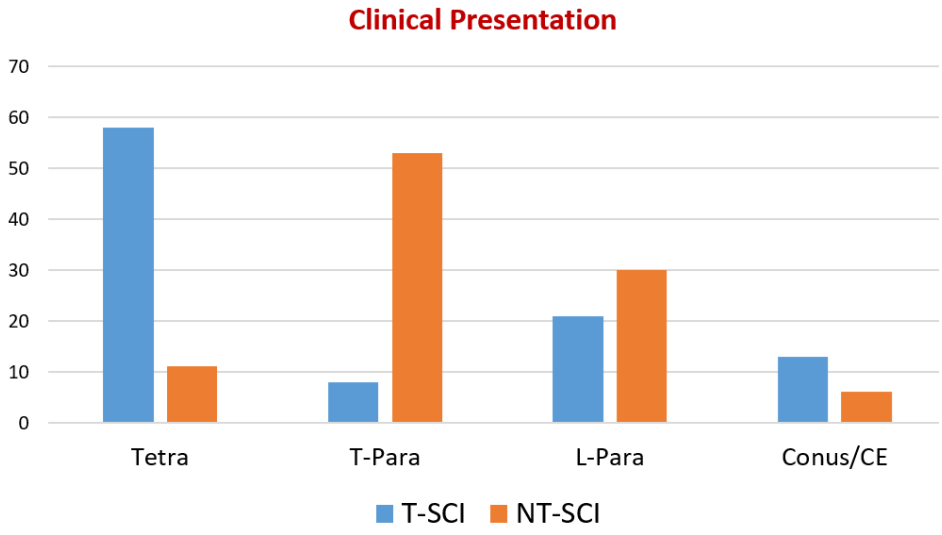


In this study population the most common Neurological level of Injury among Traumatic SCI was cervical where as it was Dorsal and lumbar in case of NT SCI. This is well explained by the fact that he most common site of potts spine and degenerative myelopathy are Dorsolumbar. The complication profile among the study subjects was overlapping and almost 90% had either one or more complications either on admission or during the course of study duration ranging from easily amenable mild urinary tract infections to more complex to treat entities like intractable chronic pain and depression. The most prevalent ones were pain, UTI and depression in decreasing order of frequency (in 83%, 78% and 70% respectively) and the least prevalent ones were Pressure ulcer (PU 9%) and Deep vein thrombosis(DVT-4%). And significant spasticity (49%) and respiratory complications (28%) were ranged in between. All the subjects presenting with pain described it as severe in intensity with high initial VAS score being more than or equal to 7 when equated with a ten point numerical scale. One more entity, the most complex and difficult to be addressed was depression. As per Beck's depression inventory, the level of depression ranged from mild mood disturbance to severe depression (score 14-38). Interestingly the incidence of depression were higher in subjects aged more than 40 years with NTM and poorly responding to treatment warranting continuous external motivation whereas the level of depression was higher in those aged less than 40 years with T-SCI despite the lower incidence when compared to the previous cohort, yet amenable to specific and supportive treatment which in turn positively influenced their rehabilitation program.

Graph 3: Clinical presentation.



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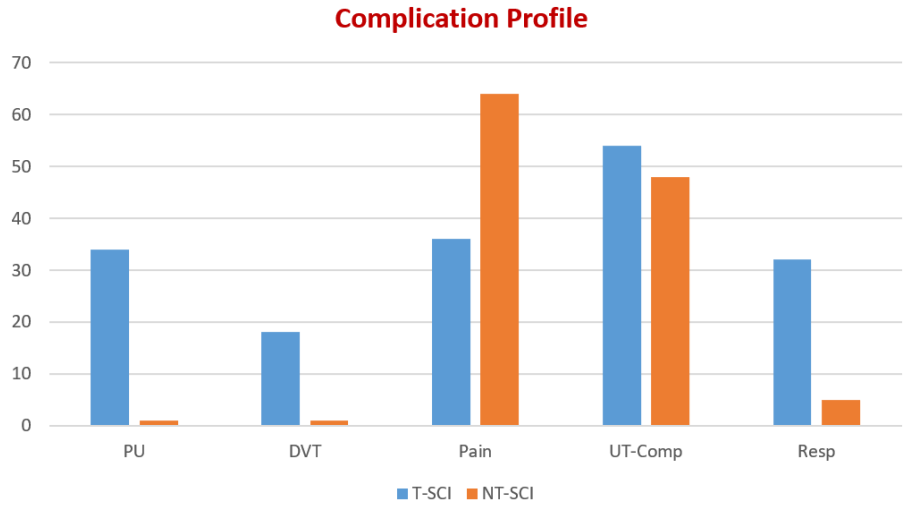
Graph 4: complication profile.



Outcome Predictors and Rehabilitation Potential

Here the term 'outcome' denotes the functional outcome. To determine the level of functional independence FIM and SCIM-III were used. AMI is an indirect measure to predict functional independence by determining the ambulatory potential which in turn through the gross estimation of motor power of specific muscle groups of lower limbs.

For this study purpose, the favorable functional outcome was determined as either one or both of the following.

- Total FIM gain of 25 or more at 3 months and / or mean FIM gain of minimum 8 per month.
- Total SCIM gain of 20 or more at 3 months and / or mean SCIM gain of minimum 8 per month.

And various factors affecting the functional outcome were analyzed and outcome predictors were identified.

The term 'Rehabilitation potential' means the inherent ability of the subject that can be utilized to maximize the functional independence. It is a composite measure of patient's participation and the factors influencing it, either directly or indirectly, and also the resources available. The impact of factors influencing the rehabilitation potential can be assessed indirectly by FIM gain and FIM efficiency which are calculated from the assessment (FIM Score) before and after addressing the specific factor identified. FIM Gain is the difference between pre and post rehabilitation ($FIM^{discharge}$ - $FIM^{admission}$) or pre and post factor specific intervention (treating pain or addressing depression…etc). And FIM efficiency is the FIM gain against the time.

Table 2: Intergroup Comparison (Matched Sample-Age, Sex, ASIA).

Parameter	T-SCI	NT-SCI
Initial FIM	Low	High
FIM Gain	More	Less than T-SCI
FIM Efficiency	++++	++
Injury (C: IC)	6:94 (Overall: 34:66)	6:94
Spasticity	66%	84%
Achieved Independency-Bladder/ Bowel Control	52%	78%
Depression	++	++++

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Outcome predictors Identified

Major outcome predictors identified were age, etiology, time of initial presentation, primary diagnosis, complete/ incomplete cord involvement, extent of segmental involvement, motor and neurological level on admission, bladder and bowel involvement, comorbidities, pain, spasticity, complications and psychological issues.

Table 3: Positive and Negative Predictors.

S.No	Positive Predictors	Negative Predictors
1.	Age less than 40 years	Age more than 40 years
2.	Acute or sub-acute onset	Gradual onset over months
3.	Early diagnosis	Delay in diagnosis
4.	Treatable cause	Cause with no specific treatment
5.	Arrested pathology	Ongoing pathology
6.	Symptom onset – Primary treatment interval <1month (earlier the treatment better the outcome)	Symptom onset – Primary treatment interval >1month
7.	LOS-P < 2 weeks	LOS-P > 2 weeks
8.	LOS-R< 4 months	LOS-R> 4 months
9.	Incomplete Injury	Complete Injury
10.	Lumbar or lower paraplegia	Thoracic paraplegia and tetraplegia
11.	Multiple / extended segmental involvement	Segmental involvement limited to one or two levels
12.	AMI >40	AMI <40
13.	Bladder or bowel independency	Long term indwelling catheter / unbalanced bladder and bowel
14.	No Comorbidities	With Comorbidities (Diabetes has stronger impact)
15.	Comorbidities under control	Newly diagnosed comorbidities with multiple organ system involvement at the time of diagnosis Long standing comorbidities with poor compliance
16.	No / mild Spasticity grade <2	Significant Spasticity grade >/=2 interfering function and rehabilitation
17.	No pain / Pain amenable to treatment	Chronic and severe pain
18.	No Depression / mild mood disturbances/ borderline clinical depression / any level responding to comprehensive approach	Moderate to severe Depression
19.	No complications	With complications like UTI/RTI/PU/DVT

The overall outcome predictors identified were more or less similar in traumatic spinal cord injury and Non traumatic myelopathy but with different presentation, varied demographic correlation and level of association and with varied impact on functional outcome in each cohort. So that the predictors with statistically significant impact were identified in the cohorts T SCI and NTM separately and analysed. Multi variate analysis was used for statistical analysis of outcome predictors.

Table 4: Prognostic Indicators Identified: T-SCI.

Variable	Multivariate p Value
Age	0.000*
Associated #	0.002
Complications • HO • DVT • PU	 0.021 0.034 0.046
Spasticity	0.046
Depression	0.049

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Table 5: Prognostic Indicators Identified:NT-SCI .

Variable	Multivariate p Value
Age	0.000*
Depression	0.0012
Pain	0.002
DM	0.036
Arrested / ongoing	0.049

It was evident from this study that the incidence of a factor didn't correlate with its level of impact on functional outcome. Most of the outcome predictors with strong statistically significant impact on functional outcome were either modifiable or treatable (UTI, PU, Pain, Spasticity) when compared to age, a non-modifiable factor. UTI was the one which had higher prevalence (78%) as well as with stronger statistical significance (p value 0.0001), where as in case of PU, despite the lower incidence (9%) among the study subjects, showed stronger statistically significant impact (p 0.0002) on the functional outcome. Among the co morbidities DM outweighed the others in prevalence as well as significance level (0.044). Length of stay during primary treatment (p value <0.0004) had stronger impact on the outcome than the LOS during rehabilitation (p value <0.0148).

In addition, it is evident from this study that by addressing modifiable predictors, rehabilitation potential can be improved. By addressing the pain and depression with appropriate measures, the FIM and SCIM improved with statistically significant gain. In contrary increasing the length of stay during rehabilitation did not improve the FIM gain significantly in proportion with the duration so that the overall FIM efficiency decreased which might negatively impact cost effectiveness [6-13].

CONCLUSION

The demographic presentation & complication profile of Non traumatic myelopathy differs from Traumatic Spinal cord injury. Though the initial FIM was lower in the T-SCI group, FIM gain and efficiency were more than NT-SCI. Age is the most important predictor in both groups. By addressing depression and pain, functional outcomes can be improved in the NT-SCI group. In the case of T-SCI group complication prevention, early identification, and timely interventions are the keynotes to improving functionality.

By identifying and analyzing functional prognostic indicators, rehab potential can be predicted so that effective and customizable rehabilitation protocol can be formulated with realistic goal settings to maximize functional outcomes.

Limitations Of The Study

- This was an institution based study
- Small sample size
- Non representative sample
- NTM with additional supra spinal involvement were not included in this study.
- Cumulative effects with simultaneous presentation of different combinations of multiple factors were not studied in detail.
- Varied levels of subject participation in rehabilitation program was not studied.
- Family support and care giver's burden were not included for analysis of outcome prediction.
- Impact of availability and accessibility of different resources on rehabilitation and the impact of different rehabilitation approaches on outcome were not assessed
- Long term follow up was not done and functionality at community level and the factors affecting it were not studied.

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