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Traumatic spinal cord injury, benefits of early transfer to a spinal injury centre

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STUDY DESIGN: Retrospective observational study.
OBJECTIVE: The study aims to evaluate the effects of early transfer of individuals with traumatic spinal cord injuries to a specialist spinal injury centre, focusing on the duration of hospital and intensive care stays, as well as the incidence of medical complications.
SETTING: Regional Spinal Injuries Centre, UK.
PATIENTS AND METHODS: All patients with traumatic SCI admitted over a 4-year period to our Regional Spinal Injury Centre were included in this study. A total of 104 patients were divided into 2 groups: those referred within 48 h (34 patients) and those referred later after the injury but within 2 months of injury (70 patients). There were no differences in the number of patients with tetraplegia or paraplegia or in the average age or sex between the two groups. there is no significant difference in the incidence of associated injuries between the 2 groups.
RESULTS: Patients who were transferred early stayed less in the ICU than did those who were transferred late (9 and 25 days, respectively; $p < 0.05$). The percentage of patients requiring ICU stay was also significantly lower (from 41–9%; $p < 0.001$); 24% of patients in the early group had medical complications, while 45% of patients in the delayed group had these complications ($p < 0.05$).The average length of hospital stay (± SD), including rehabilitation, in the early admission group was 121 (86.9) days, while that in the delayed admission group was 188 (84.9) days ($p < 0.0001$).
CONCLUSION: Earlier admission of traumatic SCI patients to a spinal injury centre is associated with shorter acute care period, shorter total hospital stay and reduced preventable complications.

Spinal Cord Series and Cases (2025)11:30; https://doi.org/10.1038/s41394-025-00724-y

INTRODUCTION

Spinal cord injuries (SCIs) are uncommon yet devastating cause of disability with a varying global incidence of 11–83 people per million inhabitants per year [1, 2].

Traumatic spinal cord injury (TSCI) reportedly affects 12.1–57.8 individuals per million people per year [3, 4]. The mechanical, physiological and psychological instability that results in multisystem dysfunction, necessitates the use of a multidisciplinary approach to provide optimum care for individuals with such relatively rare injury.

The benefits of early/direct transfer of SCI patients to a specialist centre, in terms of shorter hospitalization, reduced incidence and severity of medical complications, and possibly a better outcome, were recognized [5–10]. Expert consensus recommends expeditious referral and transfer of suspected traumatic SCI to a specialized centre (within 24 h) [11].

The aim of this study is to retrospectively analyse the data of a Regional Spinal Injury Centre in the UK, of all TSCIs admitted and compare those who were referred within 24–48 h of injury and those who were referred later than that in terms of the following:

- Total length of hospital stay (acute & rehabilitation)
- Length of ICU stay at the referred hospital and in the spinal injury centre
- The medical complication rates, including venous thromboembolism (VTE), pressure ulcers and respiratory complications, were recorded upon admission and within 3 days of transfer.

PATIENTS & METHODS

All the data was retrospectively obtained from patients records and from the centre database. A total of 251 patients were admitted to the regional spinal injury centre (SIC) over a 4-year period (between 2000 and 2004); of these patients, 113 patients (64.6%) had traumatic causes.

Our SIC is regional, covering all hospitals in Yorkshire, patients were transferred from at least 20 different hospitals including level 1 trauma centre, also received from site of injury and abroad.

Inclusion and exclusion criteria

Patients with nontraumatic causes (n = 76), those admitted after 60 days of injury (n = 9) and those admitted with no spinal cord injury, i.e., intact neurologically (n = 62), were excluded.

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Received: 12 August 2024 Revised: 29 September 2025 Accepted: 13 November 2025
Published online: 02 December 2025

Table 1. Study groups patients' Characteristics.

		Group A N = 34	Group B N = 70
Gender (%)	Males	28 (82.4)	55 (78.6)
	Females	6 (17.6)	15 (21.4)
Mean Age (SD)	Total	43.3 (19.5)	41.4 (16.9)
	Males	43 (17.7)	39.7 (16.4)
	Females	44.3 (28.4)	47.6 (17.7)
Trauma Type (%)	RTA	12 (35)	29 (41)
	Falls	15 (44)	28 (40)
	Sport	6 (18)	7 (10)
	Violence	1 (3)	6 (9)
Level of SCI	Tetraplegia (%)	16 (47)	36 (51)
	Paraplegia (%)	18 (53)	34 (49)
Associated Injuries	Number of patients (%)	10 (29.4)	20 (28.6)
Days to transfer to SIC (Median)		1 day	21 days

Patients were then divided into two groups:

Group A included all patients referred within 24–48 h of SCI, 34 patients were referred after an average of 0.6 day and are included. Most patients in this group were admitted within 2 days of injury, the reason for the delay was mostly due to beds availability.

Group B included patients referred later and admitted between 7 and 61 days after SCI, some of them were admitted to the acute ward of the SIC and others were admitted in the spinal injury rehabilitation ward within the centre. The delay observed was due to delayed referral from the receiving hospital, especially foreign hospitals, spinal injury surgical intervention, bed availability in the SIC or due to associated injuries management.

The number of days in hospital was calculated from the date of injury and the date of discharge from SIC.

The number of days spent in the intensive care unit (ICU) at the hospital of origin and at the centre were averaged per patient, and the percentage of patients who required ICU stay in each group was calculated.

The following medical complications were identified on transfer:

- Decubitus ulcers
- Respiratory complications, e.g., pulmonary oedema & chest infections
- Deep vein thrombosis (DVT) and pulmonary embolism (PE)

The number of patients with complications was recorded per group, and the percentage of patients with these complications within each group was calculated. Missing data were noted for 5 patients.

The medical complications observed in group A is the incidence of these complications in the SIC throughout their acute stage.

The presence of associated musculoskeletal injuries is noted and percentage of patients in each group is calculated, Z test is used to determine difference significance.

The following injuries were found: limb fractures, pelvic injuries, chest injuries including haemothorax, pneumothorax and head injuries.

The Microsoft Excel® statistical package was used for statistical analysis. Mann-Whitney U test is used to determine the statistical significance of differences between groups, and T test was used for differences between means & proportions. Regression analysis was used for correlations between variables. P Value of <0.05 is considered significant.

Table 2. ASIA Impairment Scale (AIS) scores of the study groups.

AIS	Group A %	Group B %	*p* Value
A	38.2	45.7	**0.46**
B	17.6	12.9	**0.60**
C	32.4	27.1	**0.57**
D	11.8	14.3	**0.72**

The bold numbers are the *p* value (statistical significance) of difference between the two groups; >0.05 are insignificant statistically.

RESULTS

A total of 104 patients were included in this study; 82 were males (79%), and 22 were females (21%), with a mean age of 42 ± 17.7 years.

Group A included 34 patients referred acutely within 48 h and admitted within 7 days of referral, 6 females and 28 males with an average age of 43 years. Sixteen (47%) patients had tetraplegia, and 18 (53%) had paraplegia. Mean time to refer to SIC was 0.62 day with a median time to transfer of 1 day. Fourteen patients (44%) were directly transferred. 10 patients (29.4%) had associated injuries including: limb fractures (5), chest injuries (4) and head injury (1).

Group B included 70 patients referred after an average of 18.2 days and admitted between 8 and 61 days after SCI. They were 15 females and 55 males with an average age of 41.5 years. 36 (51%) patients had tetraplegia, and 35 (49%) had paraplegia; the median time to transfer was 21 days (Table 1).

There is no significant differences in age, sex, associated injuries or injury severity (AIS) between the two groups (Table 2).

Patient characteristics

47% of patients in group A and 51% of patients in group B had tetraplegia ($p > 0.1$) (Table 1).

The severity of spinal cord injury was measured using the American Spinal Injuries Association Impairment Scale (AIS) and was analysed; there was no statistically significant difference in the percentage of patients in each scale between the 2 groups. (Table 2).

Patients in group A were referred after an average of 0.6 day from onset and 53% were transferred to the SIC within the same day (mean time to transfer = 1.7 days).

Patients in group B were referred after an average of 18.3 days and admitted to the SIC after an average of 7.6 days of referral.

Associated injuries

10 patients of group A (29.4%) had associated injuries, and 20 patients of group B (28.6%) had such injuries. ($p = 0.46$).

Mechanism of traumatic SCI injury

The leading mechanism of SCI in this series falls (43 individuals, 41.3%), followed by road traffic accidents (41 individuals, 38.7%), sport-related injuries (13 individuals, 12.5%) and violence (including suicide attempts), which were the causes of SCI in 7 patients (6.7%) (Fig. 1).

Length of stay

The average total length of hospital stay (both acute and rehabilitation) was 121.3 days and 187.7 days for group A and group B, respectively. The difference (68 days) was statistically significant ($p < 0.0001$). Length of stay in the SIC was also

statistically significant, group A patients stayed 43 days less than group B (Table 3, Fig. 2).

Regression analysis of the relationship between the number of days to transfer to the centre and length of stay for the whole sample (n = 104) revealed a statistically significant positive correlation ($R^2 = 0.6$, $p < 0.00001$) (Fig. 3).

Stay in the intensive care unit

Although the level and severity of spinal cord injury was the same between the groups, we showed that the number of patients requiring ICU stay in group A was 9 (8.8%), while 29 (44.6%) patients in group B required ICU care ($p < 0.0005$) (Fig. 4).

We also showed that the average number of days spent in the ICU per patient was 9.3 in group A and 24.9 in group B ($p < 0.05$) (Table 3).

Medical complications

Medical complications present upon admission were recorded and are listed in Table 4**;** 8 patients with 9 complications (23.5%) were observed in group A, and 32 patients with 38 complications (49.2%) were observed in group B. The difference was statistically significant ($p < 0.02$).

DISCUSSION

Spinal Cord Injury remain relatively uncommon, and mechanical, physiological and psychological instability results in multisystem dysfunction. Specialist comprehensive care centres for SCI were established mainly in developed countries. The first spinal injury centre opened in Aylesbury, England, in 1944 under the supervision of Sir Ludwig Guttmann. Guttmann's philosophy was that "rehabilitation following spinal cord injury should not be dissociated from the acute treatment period" [12].

In 2001, Celani et al. reported on TSCI individuals admitted to a nonspecialized inpatient rehabilitation facility after an average time from the event of 54.6 days, they concluded that rehabilitation should no longer be considered separate from the management of the acute phase in SCI patients [13]. The results of this particular study from Italy were similar to the results from individuals admitted late to our centre in terms of longer stays and higher incidences of medical complications.

Due to the relative rarity of SCI, about 40 per million per year in the UK, regional spinal injury centres were established based on the availability of experienced multidisciplinary team, leading to the availability of comprehensive expert care with no dissociation between acute care and rehabilitation, as prescribed by Sir Ludwig Guttmann.

Our spinal injury centre is located within a general hospital, with acute beds ward and spinal rehabilitation ward, input from Orthopaedic, Neurosurgery & Neurology, is available for timely interventions under one roof, the centre is covering a population of more than 5 million people (so designs due to relative rarity of spinal cord injury).

The spinal injury centre personnel are a multidisciplinary team of surgeons, spinal rehabilitation physicians, specialist nurses and allied specialities include neuro-urologists, spinal surgeons, neurologists. That is in addition to physiotherapists, occupational therapists, clinical psychologist and a social worker, all are experienced in dealing with spinal cord injury people. The aim is to help soft landing of these patients into the community with minimum complications and maximum possible recovery and independence.

NICE guidelines on initial assessment and management of spinal cord injuries states that all acute traumatic spinal cord injury patients are to be transported to the nearest major trauma centre. After initial assessment and management, "communication" with the linked spinal injury centre is to be established within 4 h of injury [14].

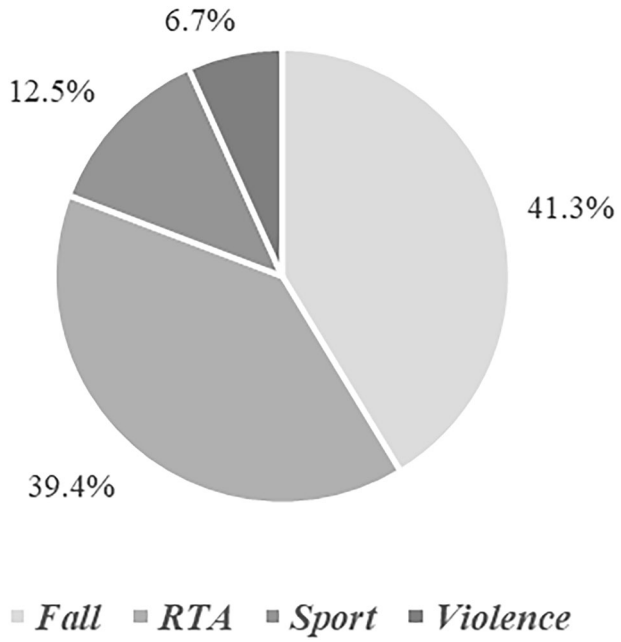

Fig. 1 Causes of traumatic SCI.

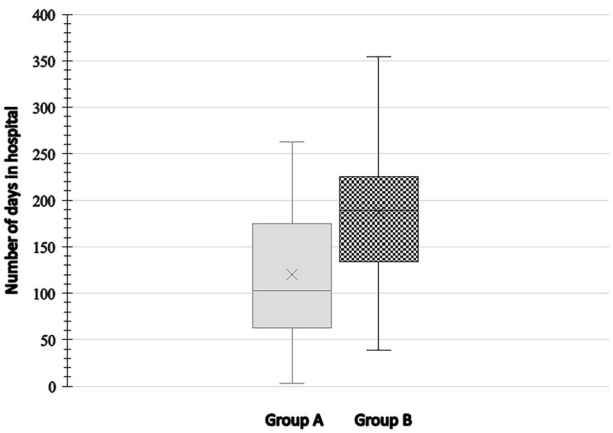

Fig. 2 Total Length of hospital stay for the groups ($p < 0.0001$).

Table 3. Results of statistical analysis of differences between group (A) and group (B).

	Group A N = 34	*Group B N = 70*	*P Value*
Referral to admission to SIC (Mean ± SD)	1.7 ± 2.6	7.6 ± 6.6	<0.0001
Length of stay in Hospital (Mean ± SD)	121.3 ± 68.9	187.7 ± 84.9	<0.0001
Length of stay in SIC (Mean ± SD)	119.2 ± 69.1	162.5 ± 82	<0.0001
Number of days in ICU per patient (Mean)	8.5	24.9	<0.05
Number of patients required ICU stay (%)	4 (11.8)	29 (41.4)	<0.0005
Medical complications (%)	8 (23.5%)	32 (49.2%)	<0.05

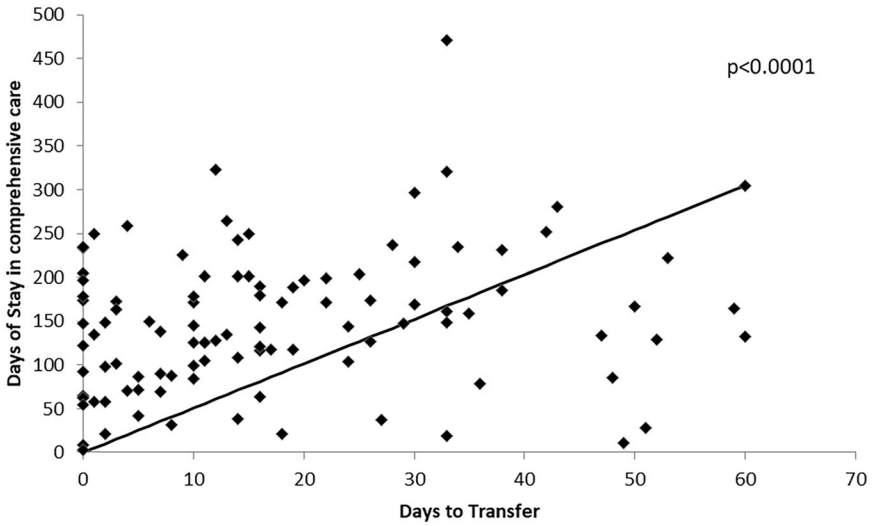

Fig. 3 Correlation between the time to transfer to SIC and length of hospital stay.

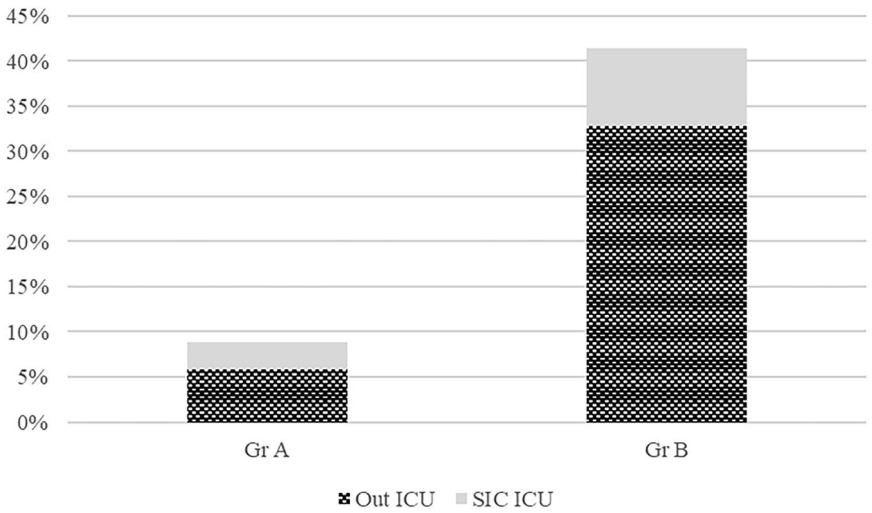

Fig. 4 Percent of patients requiring intensive care unit stay.

Table 4. Number of medical complications observed between groups.

	Group A N = 34	Group B N = 65	
Pressure Ulcers	5	21	
Chest Complications	2	9	
Venous Thromboembolism	2	3	
Surgical infections & Failure	0	5	
Total	**9**	**38**	
Number of patients (%)	8 (23.5%)	32 (49.2%)	$p < 0.05$

At the time of this study, patients with suspected spinal cord injuries were admitted directly from hospital accidents & emergency department or were transferred immediately (or within the same day) from hospitals in the region.

We have shown here that there is a reduction in the acute care period as well as in the total length of hospitalization if patients are referred and transferred promptly to specialist care. Parent et al. [15], in their review of the impact of specialized SCI centres, concluded that "although the evidence reviewed is weak, it all points in the same direction, namely, that specialized SCI centres of care consistently reduce length of stay in hospital, complications and improve neurological recovery". We did not study neurological recovery in this study, but there is evidence that patients who were transferred promptly to an SIC with AIS (C&D) paralysis were able to ambulate normally when treated with active physiological conservative management (APCM) [16]. Studies from different regions around the world have reported different outcomes, perhaps due to the lack of standardization of a "spinal injury centre"; however, it is recommended that patients with spinal cord injuries be referred to specialist care within 24 h, [17].

In this study we have shown that delayed referral to specialist care from receiving hospitals is the main reason of delay. Standardizing the scope of service of specialist spinal injury centres and their placement in hospitals with multidisciplinary services, we believe it will enhance their capability of acute management of TSCI patients and any associated injuries.

CONCLUSION

In this series of patients admitted to our Regional Spinal Injury Centre, we showed that prompt referral and admission to spinal

injury centre is associated with significant reduction in the acute care period, as indicated by the length of ICU stay, total length of hospitalisation and reduced incidence of preventable medical complications.

STUDY LIMITATIONS

- Injury severity score (ISS) at the referring hospital was not available to us.
- This is the experience of a single regional SIC.

DATA AVAILABILITY

Additional data are available from the corresponding author upon reasonable request.

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AUTHOR CONTRIBUTIONS

Alageli NA: Data analysis, writing and revising. Raza WA: was responsible for collecting the data and helping in writing and revising the article

COMPETING INTERESTS

The authors declare no competing interests.

ETHICAL APPROVAL

Was not required since the article is mainly a retrospective statistical data, no patients' IDs are included. Also the study was presented in the hospital meetings at the time. We confirm that all methods were performed in accordance with the reevant guidelines and regulations.

PATIENTS CONSENT

Not applicable for the study as this is not an experimental study and no Identifiable images of human subjects are included in the article.

ADDITIONAL INFORMATION

Supplementary information The online version contains supplementary material available at https://doi.org/10.1038/s41394-025-00724-y.

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