

Surgical Outcomes of Patients with Traumatic Spinal Cord Injuries in Three Referral Hospitals in Cameroon: Retrospective study

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Abstract

Background: Traumatic spinal cord injuries (TSCIs) represent a major global health challenge affecting survival and quality of life. In resource-limited settings, their management is complicated due to restricted healthcare access and a high incidence of complications. This study aimed to evaluate the surgical outcomes of patients with TSCIs in three referral hospitals in Cameroon. **Methods:** This retrospective observational study with an analytical approach, focused on patients who underwent surgical treatment for TSCIs from January 2019 to December 2023. **Results:** The mean age of the 240 patients was 38.54±13.48 years with a male predominance of 83.8%. Road traffic accidents accounted for 62.5% of cases. At admission, 82.5% of patients presented with neurological deficits. The median time from injury to surgery was 120 hours (IQR 48 hours). Major complications included pressure ulcers (113 cases, 50.2%) and urinary tract infections (45 cases, 20%), with an overall 1-year post-surgical mortality rate of 16.8%. Age >50 years, cervical injury level, severe initial neurological deficits, and the

presence of in-hospital complications were identified as poor prognostic factors while. Frankel C and D grades at admission and surgical intervention within 72 hours post-injury predicted favourable outcomes. **Conclusion:** Early surgical intervention and less severe neurological status at admission are associated with better outcomes following TSCI in resource-limited settings. Improving early access to specialized care and addressing in-hospital complications may significantly reduce mortality and enhance neurological recovery.

Keywords: Traumatic spinal cord injuries, Surgery, Prognosis, Anterior approach, Posterior approach

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Introduction

Traumatic spinal cord injuries (TSCIs) encompass traumatic lesions of the spinal column affecting its osteo-disco-ligamentous structure, potentially compromising the integrity of the spinal cord and its nerve roots (1, 2). They constitute major medical emergencies with potentially devastating consequences on patients' quality of life, particularly in developing countries where healthcare infrastructure is often inadequate. The leading causes include road traffic accidents and falls, necessitating urgent surgical intervention to maximize recovery chances (1).

In developed countries, numerous studies have documented the positive outcomes of early surgery for TSCIs, highlighting reduced complications and improved patient prognosis (2, 3). However, in sub-Saharan Africa, particularly in Cameroon, available data remain scarce, and existing studies reveal multiple challenges, including inadequate infrastructure, prolonged treatment delays, and limited access to specialized care (4, 5). Studies conducted in developing countries are still relatively few and often constrained by small sample sizes or insufficient data, making it difficult to gain a comprehensive and detailed understanding of post-operative outcomes in patients with TSCIs (6).

This study aimed to analyze the surgical outcomes in patients with traumatic spinal injuries in three major referral hospitals located in the capital city. These are Central Hospital, a large public tertiary hospital with a functional neurosurgical unit and a general intensive care unit (ICU) with limited capacity; General Hospital, a national referral and teaching hospital with better-equipped ICU facilities and specialized neurosurgical resources; Military Hospital, a public-military facility providing neurosurgical services with moderate ICU capacity and serving both military and civilians. It seeks to address the question of the effectiveness of surgical interventions in a resource-limited context, focusing on post-operative complications and patient prognosis. By analyzing data from these hospitals, this study provides a critical assessment of current practices and aspires to offer practical recommendations for improving surgical care while contributing to global literature by proposing

solutions adapted to the realities of developing countries.

Materials and Methods

Study type, setting, and period

This was a retrospective observational and analytical study conducted in the neurosurgery units of the three major referral hospitals located in the capital city of Cameroon. These are university hospitals that serve as the primary referral centers for neurosurgical conditions in Yaoundé and Cameroon. The recruitment period spanned 5 years, from January 2019 to December 2023, and included all patients admitted for spinal trauma during this period.

Inclusion criteria and study variables

All surgically treated patients with complete medical records were included in the study. Preoperative data collected included demographic, clinical, radiological, and therapeutic variables: age, sex, injury mechanism, transport modalities, hospital facility level at initial management, the Frankel score at admission, injury level and type, time to surgical intervention, surgical approach, and procedure performed. The level of the initial healthcare facility was classified into five categories based on the national health system structure:

- Category 1: Peripheral health centers without surgical capacity
- Category 2: District hospitals with general surgery but no neurosurgical services
- Category 3: Regional hospitals with limited specialist availability and no neurosurgery units
- Category 4: Referral hospitals with ICUs and general surgical services, but without neurosurgery
- Category 5: Tertiary referral hospitals with neurosurgery units (including the Central Hospital, General Hospital, and Military Hospital).

Post-operative variables analyzed included complications, hospital stay duration, mortality, and neurological outcomes at 1 year post-operatively.

Data analysis

Data were entered using Census and Survey Processing (CsPro) software version 7.5 and analyzed using the Statistical Package for Social Sciences (SPSS) version

25.0. Fisher's exact test and Pearson's chi-square test were used to assess the associations between variables. The significance threshold was set at a *p* value of <0.05, with a 95% confidence interval.

Table 1. Distribution of patients by age and sex

Variable	Frequency (n=240)	Percentage (%)
Age (years), mean±SD	38.54±13.48	
Age groups (years)		
0–10	2	0.8
10–20	15	6.3
20–30	46	19.2
30–40	73	30.4
40–50	51	21.3
50–60	36	15.0
60–70	15	6.3
70–80	2	0.8
Sex		
Male	201	83.8
Female	39	16.2

SD, standard deviation.

Table 2. Modes of transport to hospital

Mode of transport	Frequency (n)	Percentage (%)
Private car	142	59.2
Motorcycle	48	20
Public transport/relatives	39	16.2
Ambulance	11	4.6
Total	240	100

Results*Demographic characteristics*

During the study period, 265 patients underwent surgical treatment for TSCIs. Twenty-five patients were excluded due to incomplete or missing medical records, resulting in a final sample size of 240 patients. The cohort consisted of 201 males (83.8%) and 39 females (16.2%). The age range was 4–72 years, with a mean age of 38.54±13.48 years. The most represented age group was 30–40 years (30.4%) as shown in Table 1.

Clinical and radiological findings

The leading causes of injury were road traffic accidents (n=150, 62.5%), followed by falls from heights (n=68, 28.3%). Only 11 patients (4.6%) were transported to the

hospital by ambulance. The remaining patients arrived by private car (n=142, 59.2%), motorcycle (n=48, 20.0%), or other means such as public transport or carried by relatives (n=39, 16.2%).

Two-thirds of the patients (n=160, 66.7%) initially received care in non-specialized hospitals (lower than secondary-level facilities), while the remaining one-third (n=80, 33.3%) were taken directly to secondary- or tertiary-level hospitals with neurosurgical units (Table 2).

The most commonly affected spinal levels were lower cervical spine (n=96, 40%), thoracic spine (n=88, 36.7%), lumbar spine (n=41, 17.1%), and upper cervical spine (n=15, 6.3%), as detailed in Table 3.

Figure 1 shows the distribution of patients by initial healthcare facility, while Figure 2 shows the distribution of patients according to the Frankel classification at admission.

Table 3. Distribution of patients by injury level and radiological type

	Frequency (n=240)	Percentage (%)
High cervical level (C0, C1, C2)	15	6.3
Jefferson's fracture	2	13.3
Odontoid fracture	11	73.4
Hangman's fracture	2	13.3
Low cervical level (C3–C7)	96	40.0
Discoligamentous injury	46	47.9
Discocorporeal injury	50	52.1
Dorsal level	88	36.7
Discoligamentous injury	36	40.9
Discocorporeal injury	52	59.1
Lumbar level	41	17.1
Discoligamentous injury	18	43.9
Discocorporeal injury	23	56.1

All the values given in bold in this table represent respectively the total in frequency and percentage of high cervical level (C0, C1, C2) injuries, Low cervical level (C3–C7) injuries, Dorsal level injuries, Lumbar level injuries

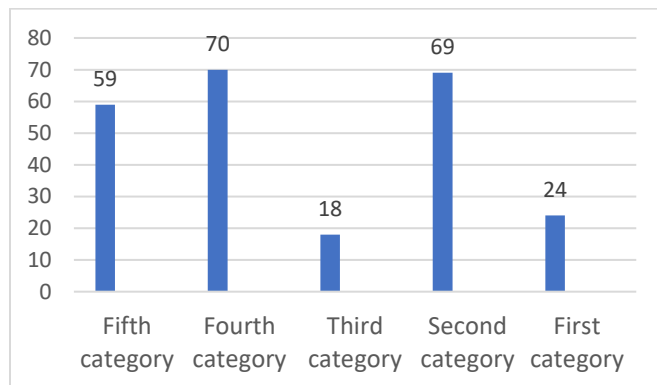


Figure 1. Distribution of patients by initial healthcare facility.

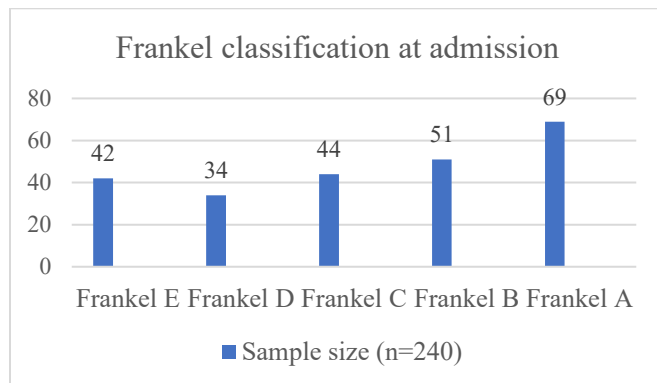


Figure 2. Distribution of patients according to the Frankel classification at admission.

Surgical management

Surgical indications included spinal instability (61.7%) and signs of spinal cord compression (38.8%). The median surgical delay was 5 days [interquartile range (IQR) 3–7 days]. Additionally, half of the patients (n=120, 50%) underwent surgery between the third day and the first week post-injury. The posterior approach was used in 58.8% of cases (all thoracolumbar and upper cervical spine injuries), while the anterior approach was employed in 41.3% (primarily for lower cervical spine injuries), as shown in Table 4. The posterior approach was used in 58.8% of cases (all thoracolumbar and upper cervical spine injuries), while the anterior approach was employed in 41.3% (primarily for lower cervical spine injuries), as shown in figures 3 and 4.

Outcome

The median duration of post-operative hospital stay was 20 days (IQR 15–30 days). Additionally, 130 patients (54.2%) had a hospital stay ranging from 10 to 30 days. In-hospital complications occurred in 59.2% of cases, with pressure ulcers accounting for half of the complications both during hospitalization and 3 months post-operatively.

The in-hospital mortality rate was 6.3%, and the 1-year mortality rate was 16.8%. Mortality data were obtained from hospital records for in-hospital deaths and follow-up phone calls to patients' next of kin for post-discharge

outcomes. Verbal autopsy techniques were used to establish the cause of death where applicable, and most deaths were attributed to complications of the spinal cord injury, such as respiratory failure or sepsis.

Table 4. Distribution of patients by surgical indications and time to surgery

Variable	Frequency (n=240)	Percentage (%)
Unstable injury	148	61.7
Signs of spinal cord compression	92	38.3
Time to surgery		
<24 hours	1	0.4
24–48 hours	10	4.2
48–72 hours	27	11.3
≥72 hours	125	52.1
>1 week	77	32.1

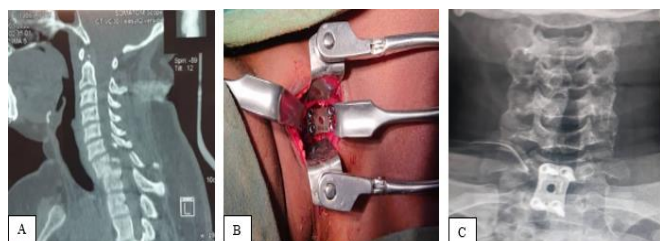


Figure 3. A: The sagittal computed tomography (CT) scan shows a fracture at the posteroinferior corner of C7 with anterior displacement (Meyerding 2) of C7 over T1, leading to canal stenosis and potentially spinal cord compression. Additionally, there is a fracture of the superior articular process of C6, but the side (right or left) needs to be specified. B: Per-operative anterior approach. C: The frontal X-ray of the cervical spine shows a C7-T1 arthrodesis plate in position.

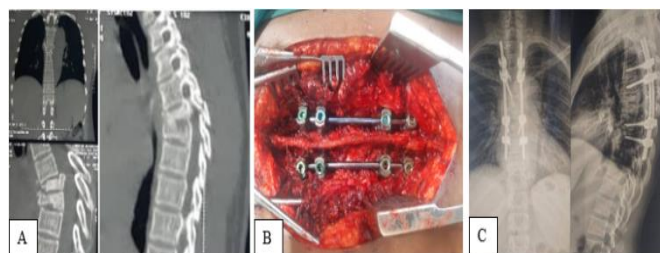


Figure 4. A: On the sagittal and coronal computed tomography (CT) reconstructions, there is a burst fracture of the T6 and T7 vertebral bodies, anterior osteoarthritis from T5 to T6, and a bilateral isthmic fracture causing canal stenosis and likely spinal cord compression. There is also dorsal hyperkyphosis. B: Per-operative reduction and fixation of fracture. C: The control X-ray of the thoracic spine shows successful arthrodesis from T4-T5 to T8-T9 with satisfactory reduction, viewed from the front and side.

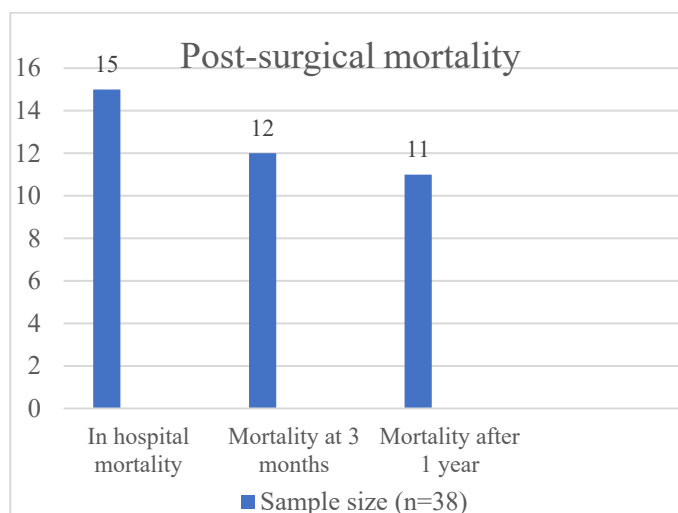


Figure 5. Distribution of patients according to post-surgical mortality.

After 1 year, 56 out of 112 patients (50%) classified as Frankel C and D at admission showed neurological improvement, as shown in Figure 5 and Tables 5–7.

A significant association was found between in-hospital mortality and the following factors:

- Age ≥ 50 years [$p < 0.005$, odds ratio (OR) 4.57]
- Cervical injury level ($p < 0.035$, OR 3.43)
- Complete spinal cord lesion ($p < 0.006$, OR 4.12)
- Requirement for respiratory assistance (i.e., mechanical ventilation or oxygen therapy due to respiratory insufficiency) ($p < 0.001$, OR 35.5)

SURGICAL OUTCOMES OF PATIENTS WITH TSCIs

- Presence of in-hospital complications ($p < 0.005$, OR 10.6) A significant association was found between cervical injury level and 1-year mortality ($p < 0.01$, OR 6.45) (Table 8).

Table 5. Distribution of patients by presence of in-hospital complications

Variable	Frequency	Percentage (%)
Type of in-hospital complications (n=225)		
Pressure ulcer	113	50.2
Urinary tract infection	45	20.0
Surgical site infection	36	16.0
Hospital-acquired pneumonia	17	7.6
Venous thromboembolic disease	14	6.2

Table 6. Neurological evolution of patients

Variable	Frequency		Percentage (%)	
Frankel score	3 months post-operatively (n=213)	1 year post-operatively (n=202)	3 months post-operatively	1 year post-operatively
Frankel A	44	32	20.7	15.8
Frankel B	40	26	18.8	12.9
Frankel C	27	26	12.7	12.9
Frankel D	30	31	14.1	15.3
Frankel E	72	87	33.8	43.1
Overall improvement	80	108	37.6	53.5

Table 7. Multivariate analysis of factors associated with in-hospital mortality

Variable	In-hospital death		OR (95% CI)	p value
	Yes, n (%)	No, n (%)		
Age				
≥50 years	8 (15.1)	45 (84.9)	4.57 (1.57–13.27)	0.003
<50 years	7 (3.7)	180 (96.3)		
Injury level				
Cervical injury level	11 (9.9)	100 (99.1)	3.43 (1.06–11.12)	0.035
Dorso-lumbar injury level	4 (3.1)	125 (96.9)		
Severity of injury				
Complete spinal cord lesion	9 (13.0)	60 (87.0)	4.12 (1.40–12.07)	0.006
Incomplete spinal cord lesion	6 (3.5)	165 (96.5)		
Requirement for respiratory assistance				
Yes	10 (45.5)	12 (54.5)	35.5 (10.47–120.35)	0.001
No	5 (2.3)	213 (97.7)		
Presence of in-hospital complications				
Yes	14 (9.9)	128 (90.1)	10.6 (1.37–82.07)	0.005
No	1.0 (1.0)	97 (99.0)		

CI, confidence interval; OR, odds ratio.

Table 8. Multivariate analysis of factors associated with 1-year mortality

Variable	1-year death		OR (95% CI)	p value
	Yes, n (%)	No, n (%)		
Age				
≥50 years	3 (7.7)	36 (92.3)	2.63 (0.76–9.0)	0.42
<50 years	8 (4.6)	166 (95.4)		
Injury level				
Cervical injury level	9 (9.8)	83 (90.2)	6.45 (1.35–30.62)	0.01
Dorso-lumbar injury level	2 (1.7)	119 (98.3)		
Severity of injury				
Complete spinal cord lesion	1 (1.8)	54 (98.2)	0.27 (0.03–2.19)	0.29
Incomplete spinal cord lesion	10 (6.3)	148 (93.7)		

CI, confidence interval; OR, odds ratio.

Table 9. Multivariate analysis of factors associated with neurological improvement at 1 year

Variable	Improvement at 1 year		OR (95% CI)	p value
	Yes, n (%)	No, n (%)		
Frankel score at admission				
Frankel C and D	61 (82.4)	13 (17.6)	6.91 (3.31–14.38)	0.001
Frankel A and B	36 (40.4)	53 (59.6)		
Cervical injury level				
Yes	42 (50.6)	41 (49.4)	0.82 (0.47–1.44)	0.49
No	66 (55.5)	53 (44.3)		
Dorsal injury level				
Yes	41 (50.6)	40 (49.4)	0.83 (0.47–1.45)	0.50
No	67 (55.4)	54 (44.6)		
Lumbar injury level				
Yes	25 (65.8)	13 (34.2)	1.87 (0.90–3.92)	0.09
No	83 (50.6)	81 (49.4)		
Surgical care delay				
<72 hours	19 (55.9)	15 (44.1)	1.12 (0.54–2.36)	0.75
≥72 hours	89 (53.0)	79 (47.0)		

CI, confidence interval; OR, odds ratio.

A significant association was found between the Frankel score at admission (C and D grades) and neurological improvement at 1 year ($p < 0.001$, OR 6.91) (Table 9).

Discussion

Demographic characteristics

The results of our study show a male predominance, with a sex ratio of 5:1, which is consistent with existing literature on spinal trauma in sub-Saharan Africa (7). The study population was young, with a mean age of 38.54 ± 13.48 years, and the high representation of the 30- to 40-year-old group reflects the typical profile of

trauma victims—working-age individuals—highlighting the socioeconomic impact of these injuries (5).

Clinical and radiological profile

Road traffic accidents (62.5%) and falls from heights (28.3%) were identified as the main etiological factors, consistent with other African studies on spinal trauma (8). These findings emphasize the urgent need to improve road safety measures and accident prevention programs, as well as to raise awareness about fall risks, particularly in high-risk occupational settings (9).

It is concerning that only 4.6% of patients were transported by ambulance to healthcare facilities, indicating an underdeveloped prehospital care system. This observation is supported by previous studies highlighting significant gaps in medical transport infrastructure across Africa (10). These deficiencies contribute to delayed management and aggravation of the initial injury. Additionally, only one-third of patients were directly transferred from the accident site to a secondary- or tertiary-level hospital, which are the appropriate facilities for managing such conditions. The fact that most patients were initially treated in lower-tier hospitals raises concerns regarding staff training and emergency response protocols for spinal trauma.

At admission, 82.5% of patients presented with neurological deficits, among whom one-third had complete spinal cord injuries. These figures underscore the severity of spinal trauma in our context and the often-poor prognosis associated with these injuries, a trend also observed in other African studies (11).

The lower cervical spine was the most affected segment (40% of cases). This prevalence is well documented in the literature and can be explained by the increased mobility of this spinal segment, making it more vulnerable to traumatic forces (11).

Surgical aspects

The delay in surgical intervention, ranging from 3 days to 1 week for half of the patients, reflects the difficulties in accessing surgical care. These delays are primarily due to erratic patient referral pathways, lack of medical transport, high treatment costs, and inadequate health insurance coverage. While problematic, these delays are comparable to the 13-day surgical delay reported by Mbaki et al. in the Republic of Congo (10). These findings highlight the need to strengthen trauma care systems to align with the Advanced Trauma Life Support (ATLS) protocols, ensuring a more efficient continuum of care.

From a surgical perspective, the anterior approach (41.3%) was the preferred technique for unstable cervical spine injuries, while the posterior approach (58.8%) was used for thoracolumbar spine injuries. These choices likely reflect adaptations to the local

surgical expertise and the availability of equipment. In many low- and middle-income countries, combined anterior–posterior approaches are less frequently employed due to logistical limitations (12).

For anterior approaches, techniques included fluoroscopy-guided cervical traction, decompression via discectomy or corpectomy, and fusion using interbody bone grafts harvested from the iliac crest, followed by anterior plating. Posterior approaches involved laminectomy or laminoplasty for decompression and pedicle screw-rod systems for stabilization. Bone grafts obtained during laminectomy were placed in the posterolateral gutters to facilitate fusion.

These techniques, although standard in resource-constrained contexts, may differ from protocols in high-income countries where combined or staged approaches are more feasible (13). Similar trends in surgical strategy have been reported in other low- and middle-income regions facing comparable structural limitations.

Post-operative outcomes

In-hospital complications affected 59.2% of patients, with pressure ulcers accounting for half of the complications during hospitalization and at 3 months post-operatively. These findings align with the 2014 meta-analysis by Zakrasek et al., which highlighted the high prevalence of pressure ulcers in low- and middle-income countries (14). The authors attributed this burden to limited resources for prevention, poor nurse-to-patient ratios, and a lack of standardized protocols. They recommended investing in basic preventive measures, including frequent repositioning, patient education, and staff training—all of which could be feasibly implemented even in low-resource settings.

At 1 year, 25.2% of patients continued to experience a reduced quality of life. Although this was not captured as a separate outcome in the Results section, clinical follow-up notes frequently mentioned persistent spinal pain as a major complaint in these patients. This finding aligns with the literature highlighting chronic pain as a frequent long-term complication in spinal cord injury survivors (15).

Furthermore, the management of pressure ulcers remains a significant challenge in our setting. Several

studies have identified poverty, low education levels, and malnutrition as key contributing factors to poor wound healing and increased complication rates in spinal cord injury patients, particularly in low-resource environments (16).

The 1-year mortality rate was 16.8%, with an in-hospital mortality rate of 6.3%. This is consistent with the findings of Mbaki et al. in the Republic of Congo (10). However, this rate is significantly higher than the 1.74% reported in France by Bouyer et al. (17), likely due to better prehospital stabilization and faster access to surgical care in high-income settings.

Advanced age (≥ 50 years) was strongly associated with increased in-hospital mortality in our cohort, consistent with global findings indicating reduced physiological resilience and higher comorbidity burden in older patients with TSCI.

Cervical injuries and complete spinal cord lesions were also significant predictors of mortality, likely due to their proximity to respiratory centers and greater likelihood of autonomic dysfunction. Notably, the requirement for respiratory assistance showed the highest OR, underscoring the impact of respiratory compromise in early mortality.

The presence of in-hospital complications, particularly pressure ulcers and infections, further compounded outcomes. These findings emphasize the need for early, aggressive multidisciplinary management, especially in elderly patients and those with high cervical injuries.

Older age is often associated with higher short-term mortality (18, 19), likely due to pre-existing comorbidities. Cervical spine injuries are known to increase mortality risk by impairing respiratory and autonomic functions (20). Complete spinal cord lesions, recognized for their severe prognosis, are linked to high mortality rates (21, 22). The underlying mechanisms involve total immobility, predisposing these patients to respiratory infections, sepsis, and thromboembolic complications, further increasing mortality risk.

Neurological recovery and prognostic factors

After a spinal cord injury, the majority of neurological recovery occurs within the first 6–9 months (23). In this

study, factors associated with better neurological outcomes at 1 year included:

- Incomplete spinal cord injuries (Frankel C and D grades) ($p = 0.001$, OR 14.09; $p = 0.001$, OR 6.91)
- Lumbar spinal injuries ($p = 0.004$, OR 2.75)
- Surgical intervention within 72 hours ($p = 0.009$, OR 2.62)

Incomplete spinal cord injuries have a more favorable prognosis (24). Lumbar spine injuries are more likely to recover due to the wider spinal canal and the presence of the cauda equina nerve roots, which have regenerative potential. Conversely, thoracic spine injuries, protected by the rigid thoracic cage but with a narrow spinal canal, tend to result in more severe and irreversible damage, explaining their poorer prognosis.

Conclusion

This study reveals that spinal trauma in our setting primarily affects young men, mostly due to road traffic accidents. The delay in surgical management is often prolonged, with patients facing significant barriers to accessing care, mainly due to economic constraints.

Early surgical intervention and less severe neurological status at admission are associated with better outcomes following TSCI in resource-limited settings. Improving early access to specialized care and addressing in-hospital complications may significantly reduce mortality and enhance neurological recovery.

The main poor prognostic factors identified were advanced age, cervical spine injury, severe initial neurological deficit, and delayed surgical intervention.

Author contributions

All authors equally contributed to conceptualization, data curation, formal analysis, funding acquisition, methodology, project administration, investigation, resources, software, supervision, validation, visualization, and in writing, reviewing & editing of the original draft.

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