

Complete Spinal Cord Injury (ASIA A at Admission) after Traumatic Spinal Injury at Bouaké University Hospital (Côte d'Ivoire): Associated Admission Characteristics and In-Hospital Outcomes

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Abstract

Objective: To describe the burden of complete spinal cord injuries (grade A of the American Spinal Injury Association Impairment Scale, ASIA, at admission), the admission characteristics independently associated with them and their in-hospital vital and functional outcomes, among patients admitted for traumatic spinal injury to an Ivorian referral centre. **Methods:** Analysis of a single-centre cohort (2017-2021 retrospective; 2025-June 2026 prospective) of 366 patients admitted for traumatic spinal injury (383 records screened, 17 excluded), reported according to STROBE. The main exposure was complete injury (ASIA A at admission) versus non-complete injury (ASIA B - E, including 43 patients without neurological deficit); a sensitivity analysis restricted the comparator to ASIA B - D. Hierarchised outcomes were in-hospital mortality (primary), complications, and neurological and walking recovery among survivors. Bivariate comparisons and multivariable logistic regression were performed. **Results:** Complete injury was present in 147 patients (40.2%). These patients more often had spinal shock (29.9% vs 10.0%) and a type C bony lesion per the AOSpine classification (51.0% vs 38.4%), with thoracic involvement as frequent as cervical involvement. The admission characteristics independently associated with completeness were spinal shock (adjusted OR: 3.46; 95% CI: 1.90 - 6.31) and type C bony lesion (adjusted OR: 1.66; 95% CI: 1.06 - 2.61), whereas non-medicalised transport was inversely associated (adjusted

OR: 0.55; 95% CI: 0.34 - 0.88). In-hospital mortality was 35.4% in ASIA A patients versus 5.5% in ASIA B - E patients (adjusted OR: 10.5; 95% CI: 5.2 - 21.0; AUC: 0.79), and 5.1% in ASIA B - D patients (crude OR: 10.2; 95% CI: 4.8 - 21.5). Respiratory complications were more frequent (32.0% vs 13.7%). Among survivors, no ASIA A patient regained functional walking (0% vs 57.0%) and recovery of at least one ASIA grade was lower (31.6% vs 53.9%). **Conclusion:** Complete injuries represent a major burden in this West African cohort, associated with excess mortality, high respiratory morbidity and very limited functional recovery. Early ASIA assessment, prevention of secondary complications and organisation of rehabilitation appear to be concrete and accessible priorities.

Keywords

Traumatic Spinal Cord Injury, Complete Spinal Cord Injury, ASIA Grade, AOSpine Classification, Functional Recovery, Côte d'Ivoire

1. Introduction

Traumatic spinal cord injury (SCI) causes lasting disability, excess mortality and considerable socio-economic costs [1]-[4]. Its severity depends primarily on the degree of initial neurological impairment. This degree is assessed using the American Spinal Injury Association Impairment Scale (ASIA), within the framework of the International Standards for Neurological Classification of Spinal Cord Injury (ISNCSCI) [5]. At the most severe end of this scale, grade A defines complete injury: the absence of any motor and sensory function in the lowest sacral segments. It reflects a severe anatomical and functional interruption of the spinal cord.

Complete injury represents the subgroup with the poorest prognosis. It carries a high risk of early mortality, related to dysautonomia, haemodynamic instability and, for high cervical injuries, respiratory failure. Its neurological reversibility remains limited [4] [6]. In high-income countries, the proportion of complete injuries tends to decrease, thanks to improved prehospital care and earlier surgical management [7] [8]. In resource-limited countries, non-medicalised transport, prolonged admission delays and unequal access to imaging and specialised surgery may, on the contrary, favour an over-representation and a poorer prognosis of complete forms [9]-[14].

In French-speaking West Africa, and particularly in Côte d'Ivoire, the specific burden, associated admission characteristics and outcome of complete spinal cord injuries have not been characterised in detail. Most African studies describe SCI as a whole without isolating this subgroup [11]-[15]. Yet the targeted analysis of complete injuries has direct prognostic and organisational implications: informing families, prioritising care, targeted prevention of complications, guiding rehabilitation. The absence of specific data currently limits clinicians' ability to estimate prognosis early and to organise care pathways in these settings.

Drawing on an Ivorian hospital cohort of 366 patients from a database built for this study, this work had three objectives: to describe the burden of complete injuries (ASIA A), that is, their frequency and characteristics; to identify the admission characteristics independently associated with them; and to assess their vital prognosis, morbidity and functional outcome, comparing them with non-complete injuries (ASIA B - E). This work is based on a simple conceptual framework: the anatomical severity of the trauma influences the initial neurological severity, which conditions complications, mortality and functional recovery, while the characteristics of the healthcare system modulate this trajectory. Our hypothesis was that complete injury was independently associated with in-hospital mortality, increased morbidity and very limited functional recovery.

2. Patients and Methods

2.1. Study Design, Setting and Period

This was a single-centre cohort study conducted in the Department of Neurosurgery of Bouaké University Hospital, Côte d'Ivoire. It combined a retrospective phase, from 1 January 2017 to 31 December 2021, and a prospective phase, from 1 January 2025 to 30 June 2026, reported according to the STROBE recommendations [16]. The 2022-2024 period was not covered by the database built for this study: this period corresponded to the transition to a new department and to a new patient-record archiving system, resulting in disorganisation and loss of records for that period. The participant flow diagram is presented in **Figure 1**.

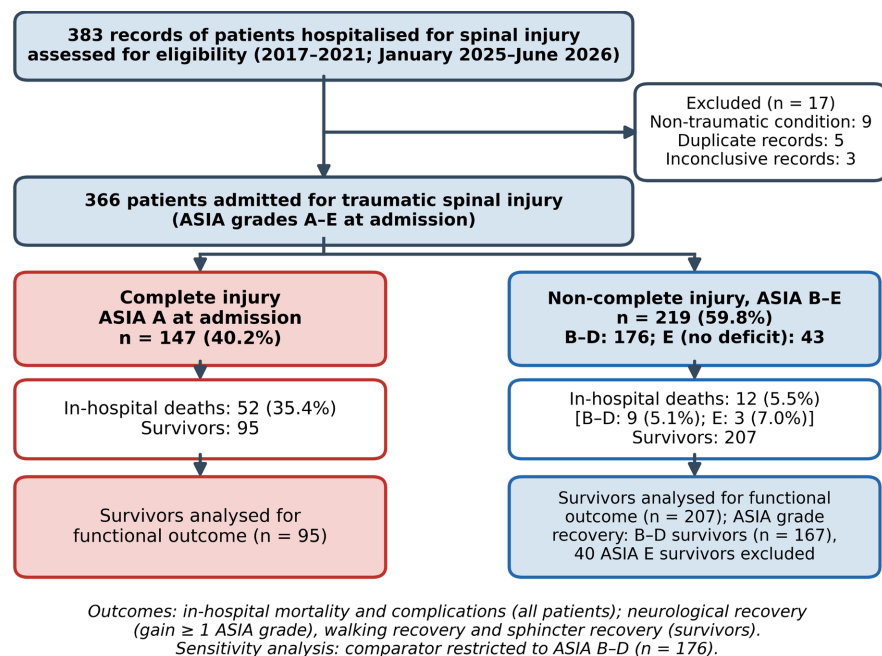


Figure 1. Participant flow diagram (STROBE): records screened and excluded, stratification of the cohort by lesion completeness at admission, mortality and numbers analysed for functional outcome.

2.2. Population

All patients hospitalised in the department for an acute traumatic spinal injury during the two study periods were eligible. A traumatic spinal injury was retained when a history of recent trauma was associated with a spinal column injury (fracture, dislocation or disco-ligamentous injury) and/or signs of spinal cord involvement on imaging—plain radiographs, computed tomography (CT) and, when available, magnetic resonance imaging (MRI)—whatever the neurological status at admission. Exclusion criteria were non-traumatic spinal conditions (disc herniation, myelomeningocele, tumours and metastases, infectious spondylodiscitis), duplicate records, and inconclusive records, defined as records in which the traumatic origin of the lesion or the admission neurological grade could not be established from the available documentation. Of the 383 records screened, 17 were excluded—9 for a non-traumatic condition, 5 duplicates and 3 inconclusive records—leaving 366 patients for analysis (**Figure 1**). No patient was excluded because of missing data on the analysed variables.

The main exposure of this study was complete injury, defined by an ASIA grade A at admission ($n = 147$). The comparator group, referred to as non-complete injuries ($n = 219$), comprised 176 patients with an incomplete spinal cord injury (ASIA B, $n = 51$; C, $n = 60$; D, $n = 65$) and 43 patients (11.7%) admitted for a traumatic spinal column injury without neurological deficit (ASIA E). ASIA E patients were retained because the study population was defined by admission for traumatic spinal injury to a neurosurgical unit, and not by the presence of a deficit: the ASIA A versus B - E contrast corresponds to the question raised at admission across the whole case-mix of the unit. Because ASIA E patients do not have a spinal cord injury in the strict sense and could dilute the comparator, the comparisons of in-hospital mortality and complications were repeated with ASIA B - D as the comparator (sensitivity analysis), and ASIA E patients were excluded from the analysis of neurological recovery, as they cannot gain an ASIA grade.

2.3. Variables and Definitions

The neurological grade was established according to the ASIA/ISNCSCI scale [5]. The first ISNCSCI examination was performed by the neurosurgical team on admission to the department, *i.e.*, a median of 2 days (interquartile range 1 - 3) after the trauma, with most patients having been referred from another facility. Grade A defines complete injury: the absence of motor and sensory function in the sacral segments S4 - S5. Grades B to D define incomplete injuries of decreasing severity, and grade E the absence of deficit. The ASIA grade recorded at admission was considered the baseline neurological grade; ASIA A therefore denotes the neurological status at admission, not definitive completeness. Neurological reassessment was not systematically performed at a predefined time after the resolution of spinal shock, and the last documented grade was used for the analysis of neurological recovery. Spinal shock was recorded when the admitting clinician documented a flaccid, areflexic paralysis below the level of injury; the bulbocavernosus

reflex and the timing of its return were not systematically recorded. Bony lesions were classified on admission imaging (CT, or plain radiographs when CT was unavailable) according to the AOSpine subaxial cervical classification for subaxial cervical injuries (C3 - C7) [17] and the AOSpine thoracolumbar classification for thoracic, lumbar and sacral injuries [18]; in both systems, type C denotes a translational injury (displacement or dislocation in any plane). Upper cervical (C1 - C2) injuries were included in the cervical level for topographical analyses but were not assigned an AOSpine subaxial morphological type, as the subaxial classification applies to C3 - C7 injuries. For multi-level injuries, the most severe classifiable morphological lesion was retained. Classification was performed by the treating neurosurgical team as part of routine care and was therefore not blinded to the neurological examination. Dislocation, recorded separately, was defined as a partial or complete loss of the normal anatomical relationships between two adjacent vertebrae on imaging, with abnormal translation or rotation, with or without facet disengagement; a partial or rotational dislocation not reaching the characterised translation of type C was not classified as type C. Spinal shock, respiratory distress, haemodynamic instability, spinal topography and the elementary lesions on imaging—spinal cord compression and contusion, dislocation, instability—were documented at admission. The outcomes were hierarchised: the primary outcome was in-hospital mortality; the secondary outcomes were in-hospital complications (respiratory, neurological, cutaneous, urinary, thromboembolic), neurological recovery (gain of at least one ASIA grade between admission and the last documented assessment), functional walking and sphincter recovery, the latter two assessed among survivors.

2.4. Ethical Considerations

The study was conducted in accordance with the Declaration of Helsinki. Bouaké University Hospital had no constituted institutional ethics committee during the retrospective period; data collection was initially authorised by the Department of Neurosurgery and the hospital management, and the study protocol, covering both components, was subsequently approved by the Institutional Ethics Committee of Bouaké University Hospital (approval no. CEI/CHU-BKE/129/2026). For the retrospective component (2017-2021), data were extracted from routine medical records and anonymised before analysis, and individual consent was waived with the approval of the committee. For the prospective component (January 2025-June 2026), informed consent to the use of clinical data was obtained from each patient or, when the patient was unable to consent, from a relative.

2.5. Statistical Analysis

Qualitative variables are expressed as counts and percentages, quantitative variables as median (interquartile range). Comparisons between complete and non-complete injuries used the χ^2 test, Fisher's exact test or the Mann-Whitney test, according to the nature of the variables and the expected counts. Two multivariable

logistic regression models were built: the first identified the factors independently associated with complete injury (dependent variable: ASIA A), the second assessed the factors associated with in-hospital mortality, including complete injury as the main exposure. Variables were selected by combining their clinical relevance, the data from the literature and their association in bivariate analysis ($p < 0.20$), while respecting a sufficient number of events per variable (at least ten). The database built for this study contained no missing data on the model variables, which allowed a complete-case analysis. The absence of important collinearity was verified by calculating the variance inflation factor (VIF), all below 1.2. Discrimination was assessed by the area under the ROC curve (AUC) and calibration by the Hosmer-Lemeshow test. The crude and adjusted odds ratios (OR) are presented with their 95% confidence interval (95% CI). In a sensitivity analysis, the comparisons of in-hospital mortality and complications were repeated after exclusion of the 43 ASIA E patients (comparator ASIA B - D, $n = 176$). Because complete injury and several outcomes were frequent, odds ratios were not interpreted as relative risks. The significance threshold was set at 0.05. Analyses were performed with Python 3.12 (pandas, statsmodels, scikit-learn). As this is an observational study, the reported associations should be interpreted as prognostic and not as causal relationships.

In the model of the admission characteristics associated with complete injury, selection favoured variables representing distinct dimensions and clinically antecedent to completeness: bony morphology (type C per the AOSpine classification), acute physiological severity (spinal shock, respiratory distress), associated traumatic burden (polytrauma), topography (cervical level), the access pathway (non-medicalised transport) and age. Several variables significant in bivariate analysis were deliberately not retained. Sphincter disorders partly overlap with the very definition of grade A, based on the abolition of sacral S4 - S5 function, and their inclusion would have introduced circularity with the modelled outcome. Spinal cord compression and contusion are radiological expressions of the cord injury of which completeness constitutes the clinical endpoint: located on the lesional pathway rather than upstream, they would have conditioned the model on intermediate variables. Dislocation, a morphological marker largely captured by the AOSpine type C category (translation injuries), was set aside for this same redundancy. Finally, the thoracic level constitutes, within a single topographical variable, the complement of the cervical level: the two could not be introduced jointly without collinearity, and the cervical level was retained as the reference contrast, because of its prognostic relevance and its association with mortality and respiratory morbidity.

3. Results

3.1. Burden of Complete Injuries

Of the 366 patients in the cohort, 147 (40.2%) had a complete spinal cord injury (ASIA A). This was the most frequent ASIA grade at admission, followed by grades

D (65; 17.8%), C (60; 16.4%), B (51; 13.9%) and E (43; 11.7%) (**Figure 2(a)**). These patients were predominantly male (81.6%), with a median age of 35 years (28 - 49), with no significant difference in age or sex from patients with a non-complete injury. Thoracic involvement was as frequent as cervical involvement within complete injuries (42.9% and 41.5% respectively), whereas cervical involvement clearly predominated among non-complete injuries (55.7%; $p = 0.008$ for cervical, $p = 0.003$ for thoracic; **Figure 2(b)**). Traumatic circumstances and the admission pathway were broadly comparable between the two groups (**Table 1**).

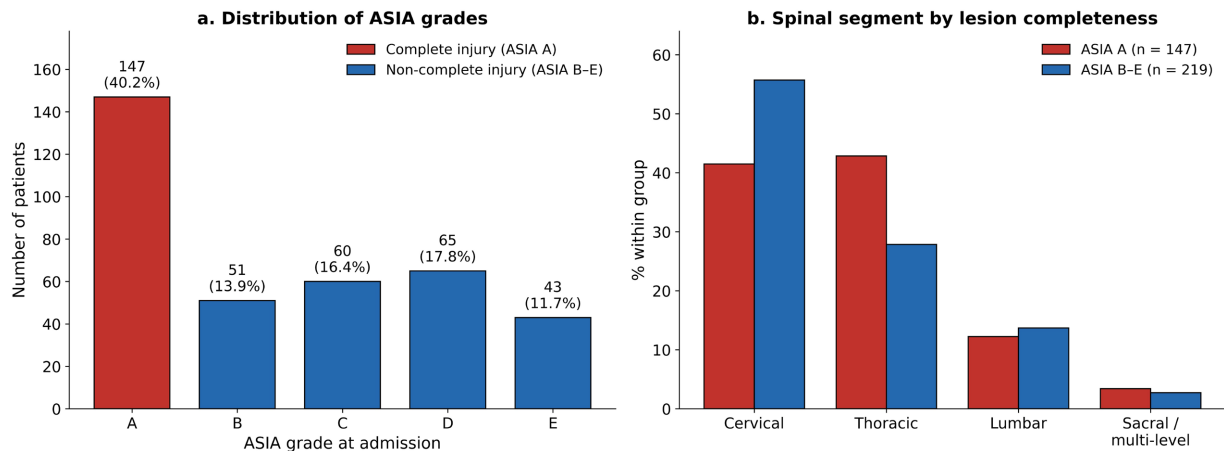


Figure 2. Burden of complete injuries. (a) Distribution of ASIA grades at admission; (b) Distribution of spinal segments by lesion completeness (complete, ASIA A; non-complete, ASIA B - E).

Table 1. Characteristics at admission by lesion completeness.

Parameter	ASIA A (n = 147)	ASIA B-E (n = 219)	p
Age (years), median (IQR)	35 (28 - 49)	35 (25 - 46)	0.345
Male sex	120 (81.6%)	176 (80.4%)	0.762
RTA (mechanism)	98 (66.7%)	131 (59.8%)	0.184
Cervical level	61 (41.5%)	122 (55.7%)	0.008
Thoracic level	63 (42.9%)	61 (27.9%)	0.003
AOSpine type C	75 (51.0%)	84 (38.4%)	0.017
Dislocation	95 (64.6%)	115 (52.5%)	0.022
Spinal cord compression	121 (82.3%)	143 (65.3%)	<0.001
Spinal cord contusion	90 (61.2%)	110 (50.2%)	0.038
Spinal shock	44 (29.9%)	22 (10.0%)	<0.001
Sphincter disorders	124 (84.4%)	103 (47.0%)	<0.001
Respiratory distress	18 (12.2%)	17 (7.8%)	0.153
Polytrauma	47 (32.0%)	52 (23.7%)	0.082
Referred	108 (73.5%)	155 (70.8%)	0.574
Non-medicalised transport	70 (47.6%)	138 (63.0%)	0.004

IQR: interquartile range; RTA: road traffic accident; AOSpine: AOSpine classification.

3.2. Admission Characteristics Independently Associated with Complete Injury

In bivariate analysis, complete injury was significantly associated with spinal shock (29.9% vs 10.0%; $p < 0.001$), type C bony lesion per the AOSpine classification (51.0% vs 38.4%; $p = 0.017$), dislocation (64.6% vs 52.5%; $p = 0.022$), spinal cord compression (82.3% vs 65.3%; $p < 0.001$), spinal cord contusion (61.2% vs 50.2%; $p = 0.038$) and sphincter disorders (84.4% vs 47.0%; $p < 0.001$) (**Table 1**). Cervical involvement was, on the contrary, less frequent among complete injuries (41.5% vs 55.7%; $p = 0.008$), as was non-medicalised transport (47.6% vs 63.0%; $p = 0.004$).

In multivariable analysis (VIF all below 1.2), the admission characteristics independently associated with complete injury were spinal shock (adjusted OR: 3.46; 95% CI: 1.90 - 6.31) and type C bony lesion per the AOSpine classification (adjusted OR: 1.66; 95% CI: 1.06 - 2.61), whereas non-medicalised transport was inversely associated with it (adjusted OR: 0.55; 95% CI: 0.34 - 0.88) (**Table 2; Figure 3**). An adjusted OR of 3.46 means that, all else being equal, the odds of a complete injury were about three and a half times higher in the presence of spinal shock; because complete injury affected 40.2% of the cohort, this odds ratio overstates the corresponding ratio of probabilities and should not be read as a relative risk. Age, introduced as a continuous variable per 10-year band, was not significantly associated with lesion completeness (adjusted OR: 1.02; 95% CI: 0.92 - 1.13).

3.3. Vital Prognosis

In-hospital mortality was very strongly linked to completeness: 35.4% of ASIA A patients died, versus 5.5% of ASIA B-E patients (crude OR: 9.44; $p < 0.001$) (**Figure 4**). When the 43 ASIA E patients, 3 of whom died, were excluded from the comparator, mortality was 5.1% (9/176) in ASIA B - D patients and the association was unchanged (crude OR: 10.16; 95% CI: 4.79 - 21.53; $p < 0.001$). In multivariable analysis, complete injury remained the factor most strongly associated with

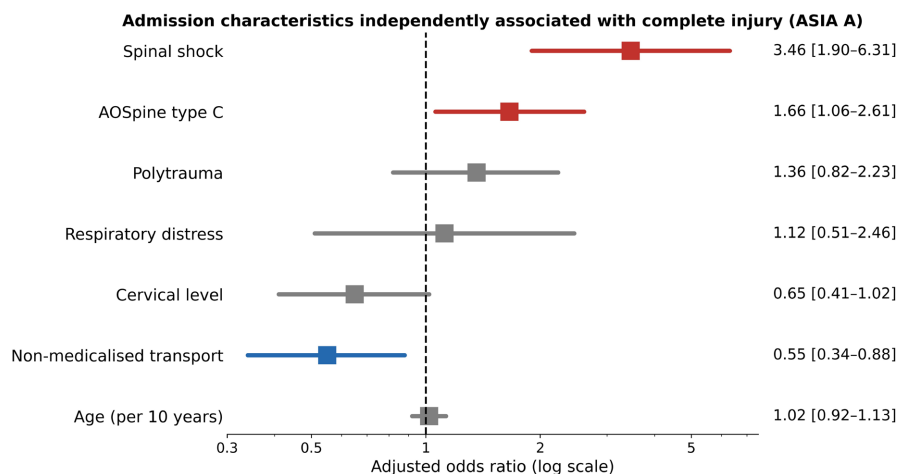


Figure 3. Admission characteristics independently associated with complete injury (adjusted odds ratios; the vertical dashed line corresponds to OR = 1).

Table 2. Factors independently associated with complete injury (ASIA A).

Variable	Crude OR	95% CI	Adjusted OR	95% CI
Spinal shock	3.83	2.18 - 6.73	3.46	1.90 - 6.31
AOSpine type C	1.67	1.10 - 2.56	1.66	1.06 - 2.61
Polytrauma	1.51	0.95 - 2.41	1.36	0.82 - 2.23
Respiratory distress	1.66	0.82 - 3.33	1.12	0.51 - 2.46
Cervical level	0.56	0.37 - 0.86	0.65	0.41 - 1.02
Non-medicalised transport	0.53	0.35 - 0.82	0.55	0.34 - 0.88
Age (per 10 years)	1.04	0.95 - 1.14	1.02	0.92 - 1.13

n = 366; events (ASIA A) = 147; 7 terms in the model; EPV = 21; VIF all < 1.2. OR: odds ratio; 95% CI: 95% confidence interval.

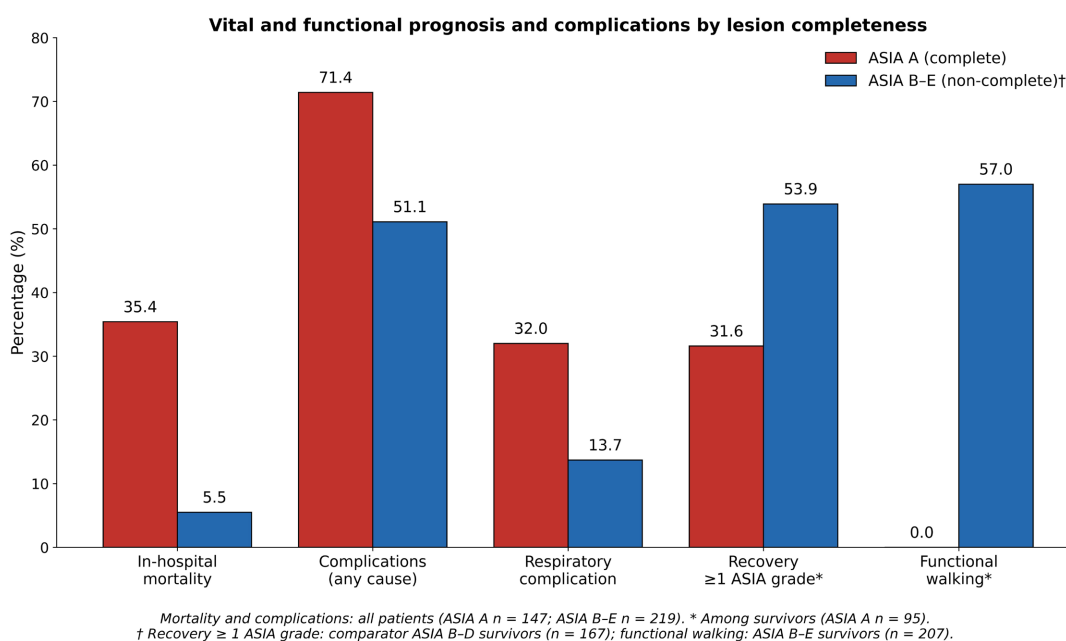


Figure 4. Vital and functional prognosis and complications by lesion completeness. Mortality and complications are calculated among all patients; the functional indicators (recovery ≥ 1 ASIA grade, functional walking) are calculated among survivors, with ASIA B-D survivors as comparator for recovery ≥ 1 ASIA grade.

mortality (adjusted OR: 10.5; 95% CI: 5.2 - 21.0) after adjustment for cervical level, respiratory distress, polytrauma and age, with good discrimination (AUC: 0.79) and no major lack of calibration detected (Hosmer-Lemeshow p = 0.54) (**Table 3**). Within complete injuries themselves, mortality was highest for cervical involvement (41.0%; 95% CI: 29.5 - 53.5), followed by thoracic (34.9%; 95% CI: 24.3 - 47.2) and lumbar involvement (22.2%; 95% CI: 9.0 - 45.2). Sacral or multi-level injuries remained few (20.0%; 1/5), which underlines the aggravating role of a high lesional level. No significant interaction was found between completeness and cervical level (p = 0.52), suggesting that the effect of complete injury on mortality was homogeneous regardless of level.

Table 3. Vital and functional prognosis and complications by lesion completeness.

Outcome	ASIA A	ASIA B - E	Crude OR	95% CI	p
Vital prognosis					
In-hospital mortality	52 (35.4%)	12 (5.5%)	9.44	4.82 - 18.51	<0.001
Mortality—adjusted OR*	—	—	10.5	5.2 - 21.0	<0.001
Complications					
Any complication	105 (71.4%)	112 (51.1%)	2.39	1.53 - 3.73	<0.001
Respiratory	47 (32.0%)	30 (13.7%)	2.96	1.76 - 4.97	<0.001
Thromboembolic	10 (6.8%)	4 (1.8%)	3.92	1.21 - 12.76	0.023
Neurological	44 (29.9%)	49 (22.4%)	1.48	0.92 - 2.38	0.104
Cutaneous (pressure ulcers)	23 (15.6%)	24 (11.0%)	1.51	0.82 - 2.79	0.189
Urinary	23 (15.6%)	23 (10.5%)	1.58	0.85 - 2.94	0.146
Functional outcome (survivors)					
Recovery $\geq$ 1 ASIA grade	30 (31.6%)	90 (53.9%)	0.39	0.23 - 0.67	<0.001
Functional walking	0 (0.0%)	118 (57.0%)	—	—	<0.001
Sphincter recovery	38 (40.0%)	75 (36.2%)	1.17	0.71 - 1.93	0.530

*Adjusted OR for cervical level, respiratory distress, polytrauma and age (AUC: 0.79; Hosmer-Lemeshow $p = 0.54$). Survivors: ASIA A: $n = 95$; ASIA B - E: $n = 207$. Recovery of at least one ASIA grade excludes the 40 ASIA E survivors (comparator ASIA B - D: $n = 167$). Sensitivity analysis (comparator ASIA B - D: $n = 176$): in-hospital mortality 9 (5.1%), crude OR: 10.16 (95% CI: 4.79 - 21.53), $p < 0.001$; any complication 98 (55.7%), crude OR: 1.99 (1.25 - 3.17), $p = 0.005$; respiratory complication 27 (15.3%), crude OR: 2.59 (1.52 - 4.44), $p < 0.001$.

3.4. Morbidity and Complications

Patients with a complete injury accumulated a heavier in-hospital morbidity: at least one complication was documented in 71.4% of them, versus 51.1% of non-complete injuries (crude OR: 2.39; $p < 0.001$). This difference was mainly driven by respiratory (32.0% vs 13.7%; crude OR: 2.96; $p < 0.001$) and thromboembolic complications (6.8% vs 1.8%; crude OR: 3.92; $p = 0.023$). Neurological, cutaneous (pressure ulcers) and urinary complications were numerically more frequent in ASIA A patients, without reaching the significance threshold (**Table 3**).

After exclusion of ASIA E patients (comparator ASIA B - D, $n = 176$), at least one complication was documented in 98 patients (55.7%) with ASIA B - D injuries (crude OR: 1.99; 95% CI: 1.25 - 3.17; $p = 0.005$), and a respiratory complication in 27 patients (15.3%) (crude OR: 2.59; 95% CI: 1.52 - 4.44; $p < 0.001$); the differences with ASIA A patients therefore persisted.

3.5. Functional Prognosis and Outcome

Among the 95 survivors of a complete injury, neurological recovery remained lim-

ited. A conversion to a less severe grade, a gain of at least one ASIA grade, was observed in 31.6% of them, versus 53.9% of survivors of an incomplete injury of ASIA grade B - D—survivors with ASIA E, unable to gain, being excluded from this analysis (crude OR: 0.39; 95% CI: 0.23 - 0.67; $p < 0.001$). This conversion was most often by a single grade (23 A → B conversions, 4 A → C, 3 A → D), with conversion to the functional grade E remaining nil (**Figure 5**). Since grade D is based on a threshold of manually tested motor strength and not on a walking criterion, its conversion does not imply resumption of walking: indeed, no ASIA A survivor, including among the 3 patients who progressed to grade D, regained functional walking, whether independent or assisted, versus 57.0% of survivors of a non-complete injury ($p < 0.001$); all ASIA A survivors remained without resumption of walking, in a wheelchair, with difficult standing or an absence of recovery. Sphincter recovery, in contrast, was not significantly different between the two groups (40.0% vs 36.2%; $p = 0.53$). These results illustrate a clear dissociation between neurological recovery—a gain of one ASIA grade may be observed—and functional recovery, resumption of walking requiring a level of motor recovery that was not reached by any survivor of a complete injury.

4. Discussion

In this Ivorian hospital cohort of 366 patients, complete spinal cord injuries (ASIA A) were of major magnitude: although representing only two patients in five (40.2%), they concentrated in-hospital mortality (35.4% vs 5.5%), respiratory morbidity (32.0% vs 13.7%) and the entirety of definitive motor disabilities, with no survivor regaining walking. The central message is that initial neurological severity is not only a descriptive marker. It constitutes the main organiser of the clinical trajectory, linking the anatomical severity of the trauma to the vital and functional outcome.

Outcome of the 147 patients with complete injury (ASIA A)

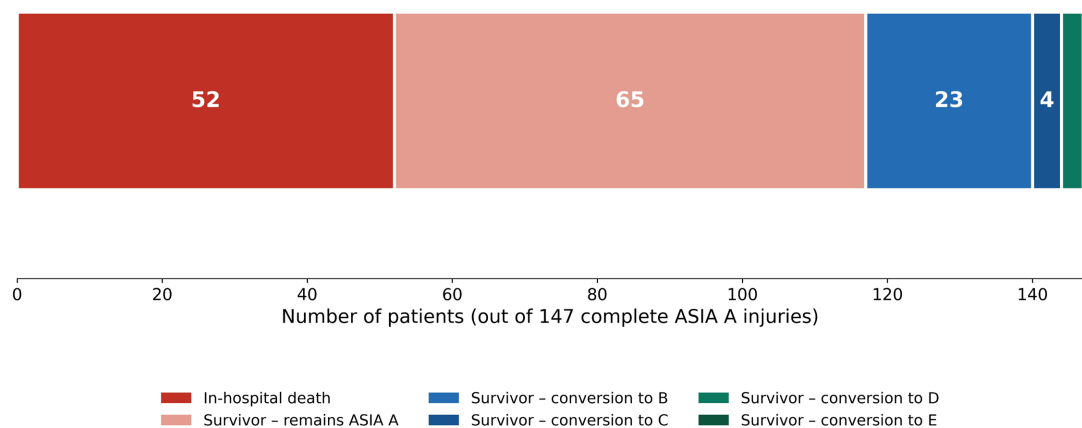


Figure 5. In-hospital outcome of the 147 patients with a complete injury (ASIA A): deaths and change in ASIA grade among survivors.

4.1. Burden, Associated Admission Characteristics and Mechanisms

The proportion of complete injuries (40.2%) is high compared with high-income country series, often below 30%, and close to African cohorts (36.5% in Ethiopia; **Table 4**). A notable finding is that thoracic involvement was as frequent as cervical involvement among complete injuries, whereas cervical involvement dominated non-complete injuries. The relative narrowness of the thoracic canal and its watershed vascularisation expose the thoracic cord to complete injuries, whereas cervical injuries are distributed across the whole spectrum of severity. Spinal shock and type C lesion per the AOSpine classification, independently associated with completeness, are consistent with a high energy transferred to the cord. Spinal shock, however, is also a transient clinical state that can mimic a complete injury, so that part of this association may reflect grading during shock rather than definitive completeness (see Strengths and Limitations). Mechanistically, the primary injury is followed by a cascade of secondary lesions—*ischaemia*, *oedema*, *inflammation*, *programmed cell death*—which extends tissue destruction and provides the rationale for strategies limiting these lesions. Since cervical level was not significantly associated with completeness after adjustment, neurological severity and lesional level appear as two distinct dimensions. The inverse association with non-medicalised transport probably reflects the triage of the most severe presentations towards medicalised transport, and not a protective effect.

Table 4. Comparison with sub-Saharan African spinal cord injury cohorts.

Study	Country	n	ASIA A	Mortality	Walking	Level of evidence
Our study	Côte d'Ivoire	366	40.2%	17.5% (hosp.); 35.4% (ASIA A)	0% (ASIA A)	3 (cohort)
Mengesha 2026 [19]	Ethiopia	252	36.5%	22.2% (30 d)	NR	3 (cohort)
Moshi 2017 [20]	Tanzania	125	NR	NR	NR	3 (cohort)

NR: not reported; hosp.: in-hospital mortality; level of evidence per OCEBM (cohort studies). Definitions of mortality (in-hospital, 30-day) and follow-up windows differ, which limits direct comparisons.

4.2. Vital Prognosis and Respiratory Morbidity

Complete injury was the main factor associated with in-hospital mortality (adjusted OR: 10.5; AUC: 0.79), with a mortality of 35.4% versus 5.5%, consistent with the Ethiopian cohort, where complete injury was strongly associated with mortality (adjusted OR: 6.5) [19]. This result reflects the expected pathophysiological role: a severe anatomical and functional interruption of the cord exposes to dysautonomia, haemodynamic instability and respiratory failure, particularly in the case of cervical involvement, where mortality reached 41.0% within complete injuries. This association was unchanged when patients without neurological deficit were excluded from the comparator (crude OR: 10.2 versus ASIA B - D),

and is therefore not an artefact of the inclusion of ASIA E patients. The respiratory excess mortality—complications more than twice as frequent (32.0% vs 13.7%)—probably constitutes one of the main mechanisms and underlines the role of critical care, as decisive as the surgical procedure in the in-hospital outcome.

4.3. From Neurological Recovery to Functional Recovery

The functional outcome of survivors was very poor: conversion to a less severe grade remained limited (31.6%), most often by a single grade, and no survivor regained functional walking. This result highlights an essential distinction: a measurable neurological improvement, for example, an ASIA A to B conversion reflecting partial sensory recovery, does not equate to a functional improvement. Recovery of walking integrates residual motor strength, postural control, balance and endurance. It is a patient-centred outcome, which conditions autonomy, return home and social participation. Its absence in all ASIA A survivors illustrates a lasting disability, beyond neurological impairment alone, and imposes realistic rehabilitation objectives: wheelchair independence, prevention of complications, bladder-sphincter management. Our results thus distinguish barely modifiable factors—initial severity, level, AOSpine—from potentially modifiable factors—delays, intensive care, prevention of complications, rehabilitation. The latter constitute windows of intervention, even in the most severe patients.

4.4. International Comparison

Our results are consistent with the large international and African cohorts, in which initial neurological severity remains the main prognostic factor for mortality and recovery [19] [21] [22]. The frequency of complete injuries and the mortality observed lie within the range reported in sub-Saharan Africa [10] and underline the specificities of resource-limited systems. The differences from high-income countries probably relate as much to the organisation of care—delays, transport, intensive care, rehabilitation—as to the universal pathophysiology of spinal cord trauma. By documenting this subgroup in an Ivorian referral centre, this study reduces the under-representation of West African data and fits within the objectives of global neurosurgery [23] [24].

4.5. What This Study Shows, Suggests and Does Not Demonstrate

What the study shows: The high frequency of complete injuries, their independent association with spinal shock and type C lesion per the AOSpine classification (and an inverse association with non-medicalised transport), marked in-hospital excess mortality and respiratory morbidity, and the absence of functional walking in survivors.

What it suggests: The value of early prognostic stratification based on ASIA assessment and of optimised organisation of care.

What it does not demonstrate: Neither a causal effect of the factors studied, nor the comparative effectiveness of surgical or rehabilitation strategies [25] [26], nor

the external validity of the associations, which require prospective multicentre confirmation.

Figure 6 summarises this conceptual framework: anatomical severity conditions initial neurological severity, which determines complications, mortality and, among survivors, neurological then functional recovery. This is an observed prognostic trajectory, and not a formal therapeutic recommendation.

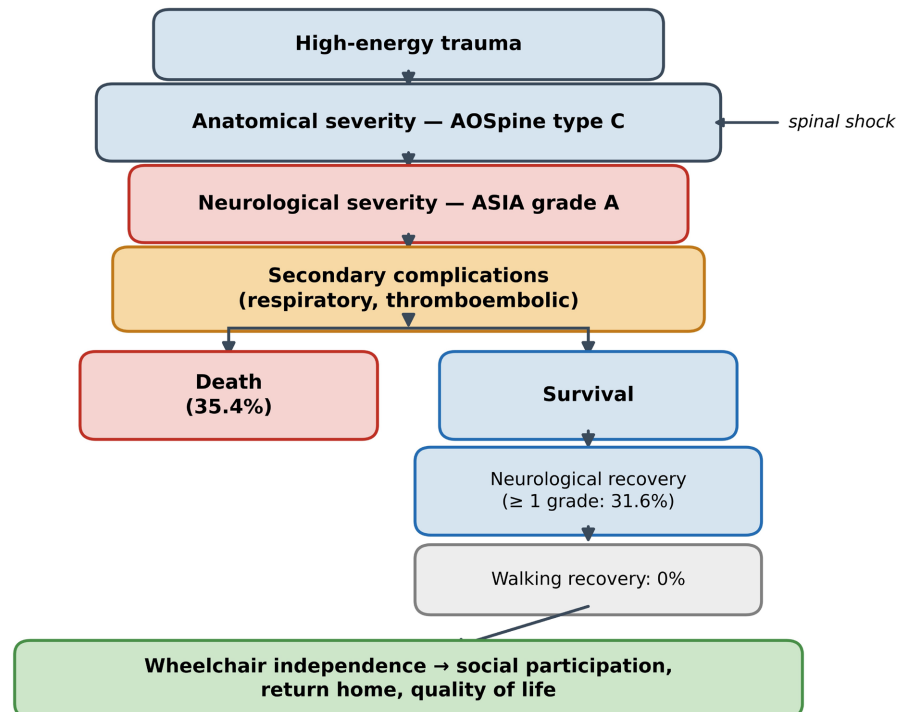


Figure 6. Conceptual framework of the prognostic trajectory after traumatic spinal cord injury, illustrated by the cohort data for complete injuries (ASIA A).

4.6. Strengths and Limitations

The main strengths are the size of the cohort, the internal quality control that led to a database without missing data on the model variables, the use of standardised classifications (ASIA grade, AOSpine classification), the joint analysis of burden, associated admission characteristics and prognosis, and multivariable analyses with verification of collinearity and calibration. Several limitations must be taken into account. The single-centre nature and recruitment in a referral centre expose to a selection bias liable to over-represent severe forms. The frequency of complete injuries should therefore not be interpreted as a national incidence. The partly retrospective component exposes to an information bias and to residual confounding: comorbidities, nutritional status, socio-economic conditions, rehabilitation adherence. The prognostic model was not externally validated, and the absence of reliable dates prevented any temporal survival analysis. The ASIA grade was assessed at admission and at a median of 2 days after the trauma. Because neurological reassessment was not systematically performed at a predefined time after resolution of spinal shock, some patients initially classified as ASIA A may have

been transiently misclassified during spinal shock; this would inflate the frequency of complete injuries and bias the association between spinal shock and completeness away from the null. Consequently, part of the observed A-to-B/C/D conversions may represent resolution of spinal shock rather than true neurological recovery. The AOSpine classification was performed by clinicians aware of the neurological status, which may have favoured a concordant classification of the most severe cases. The comparator group included 43 patients without neurological deficit; the sensitivity analysis restricted to ASIA B - D did not modify the mortality or complication results. Finally, MRI was not systematic, which prevented the analysis of intramedullary contusion or haemorrhage. Functional walking was based on a clinical categorisation, not on a validated scale (SCIM, WISCI). Data on rehabilitation and long-term quality of life were not available.

4.7. Perspectives

In the short term, the priorities concern the improvement of care pathways, the standardisation of ASIA assessment and the strengthening of complication prevention. In the medium and long term, a prospective multicentre West African registry, based on common definitions, would make it possible to validate the associations identified, to integrate standardised and patient-reported functional outcomes—quality of life, participation, return to work—to assess the impact of delays and rehabilitation, and to develop and validate prognostic models adapted to African populations [22], in line with the updated international recommendations on the management of acute SCI [27]. A specific model of functional walking constitutes the most natural extension of this work.

5. Clinical and Organisational Implications

These results translate into concrete priorities that are, for the most part, largely organisational. They are therefore accessible in the short term, even in the absence of major technological innovations: systematically performing the ASIA assessment from admission, as a major prognostic marker; in any ASIA A patient, particularly in the case of cervical involvement, instituting reinforced respiratory monitoring from admission; implementing systematic prevention of thromboembolic, respiratory and cutaneous complications; starting rehabilitation early, with realistic objectives centred on autonomy (transfers, wheelchair independence, prevention of complications, bladder-sphincter management); and providing early, realistic and progressive prognostic information to patients and their relatives, to foster shared decision-making.

6. Conclusion

In this West African cohort, complete spinal cord injuries were of major magnitude, both by their frequency and by their prognosis. Associated mainly with markers of initial lesional severity at admission, rather than with the cervical level, they were accompanied by considerable in-hospital excess mortality, high respiratory mor-

bidity and near-zero functional recovery, with no survivor regaining walking. Beyond the surgical procedure, these results argue for reinforced road safety, quality initial immobilisation and transport, active prevention of secondary complications and the development of rehabilitation pathways. Initial neurological assessment according to the ASIA classification is not only a diagnostic tool. It represents an instrument of prognostic stratification, immediately available in resource-limited healthcare systems, allowing monitoring, complication prevention and rehabilitation objectives to be guided from admission. These results provide a scientific basis for the development of multicentre prognostic models and care pathways adapted to patients with traumatic spinal cord injury in resource-limited health systems.

Author Contributions

Conceptualisation: K.Y.S. Dongo, F.S.L. Teti; data curation: Y.B. Fionko, K.J.J. Kouassi; formal analysis: K.Y.S. Dongo; methodology: K.Y.S. Dongo, F.S.L. Teti; writing—original draft: K.Y.S. Dongo; writing—review and editing: K.L.A. Derou, K.J-B. Keke; validation: A. Haidara. All authors have read and approved the final version of the manuscript and meet the ICMJE authorship criteria.

Data Availability

The anonymised data may be made available by the corresponding author on reasonable request, subject to the applicable institutional and ethical authorisations.

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Related Manuscripts

This manuscript is based on the same hospital cohort of traumatic spinal cord injuries from Bouaké University Hospital as two related works by the same authors, one of which addresses the prognostic factors of mortality and neurological recovery and the other the lesional morphology per the AOSpine classification. These manuscripts share the source population, part of the descriptive tables and the multivariable mortality model; they differ in their objective, the present analysis being centred on the subgroup of complete injuries (ASIA A). This overlap is declared to the editorial office and no data are presented as derived from independent analyses.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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