USING THE OUTCOME OF SUBAXIAL CERVICAL SPINE TRAUMA WITH COMPLETE SPINAL CORD INJURY TO DEVELOP A SCORING SYSTEM TO DETERMINE SURGICAL INTERVENTION AT NATIONAL ORTHOPAEDIC HOSPITAL DALA, KANO, NIGERIA

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Background. Complete cervical spinal cord injury (ASIA A) carries a grave prognosis with minimal neurological recovery. Surgical intervention remains controversial where presentation delays are common. This study analysed outcomes of complete cervical spine injury and developed a practical scoring system to guide surgical decision making at the NOHD, Kano, Nigeria.
Methods. A retrospective cohort study of 167 patients with traumatic complete cervical SCI (ASIA A) managed at NOHD between January 2018 and December 2024 was conducted. Data extracted included demographics, injury mechanism, time to presentation, MRI parameters (intramedullary lesion length, IMLL), haemodynamic management (mean arterial pressure, MAP), surgical timing, and 12 month neurological outcome. Multivariate logistic regression identified independent predictors of improvement. Significant predictors were weighted by regression coefficients to create a scoring system, validated by bootstrap resampling.
Results. Of 167 patients, 124 (74.3%) were male; mean age 42.8 ± 15.6 years. Only 22 (13.2%) patients showed any neurological improvement at 12 months, all of whom had incomplete baseline injuries. Independent predictors of favourable outcome were: time to surgery ≤7 days (OR 4.5; $p < 0.001$), admission MAP ≥85 mmHg maintained for first 72 h (OR 3.8; $p=0.002$), and IMLL ≤15 mm on MRI (OR 3.2; $p=0.005$). A 9 point scoring system was developed: surgery ≤7 days (4 points), MAP ≥85 mmHg (3 points), IMLL ≤15 mm (2 points). A score ≥6 predicted any neurological improvement with sensitivity 72% and specificity 86% (AUC 0.83).
Conclusion. Complete cervical SCI patients rarely recover, but a small subset with favourable predictors may benefit from surgery. The proposed scoring system emphasises modifiable factors-early decompression and haemodynamic optimisation — to guide resource allocation and patient counselling.

Key Words: complete cervical spinal cord injury; ASIA A; scoring system; surgical intervention; Nigeria.
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ИСПОЛЬЗОВАНИЕ ИСХОДОВ СУБАКСИАЛЬНОЙ ТРАВМЫ ШЕЙНОГО ОТДЕЛА ПОЗВОНОЧНИКА С ПОЛНЫМ ПОВРЕЖДЕНИЕМ СПИННОГО МОЗГА ДЛЯ РАЗРАБОТКИ СИСТЕМЫ ОЦЕНКИ НЕОБХОДИМОСТИ ХИРУРГИЧЕСКОГО ВМЕШАТЕЛЬСТВА В НАЦИОНАЛЬНОМ ОРТОПЕДИЧЕСКОМ ГОСПИТАЛЕ ДАЛО, КАНО, НИГЕРИЯ

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Цель исследования. Проанализировать исходы лечения полного повреждения шейного отдела спинного мозга и разработать практическую систему оценки для принятия решений о хирургическом лечении в Национальном ортопедическом госпитале Дало (шт. Кано, Нигерия).
Материал и методы. Проведено ретроспективное когортное исследование, в которое вошли 167 пациентов с травматическим полным повреждением спинного мозга шейного отдела (ASIA A), проходивших лечение в Национальном ортопедическом госпитале Дало в с января 2018 по декабрь 2024 г. Выборка данных включала демографические характеристики, механизм травмы, время до обращения, параметры МРТ (протяженность интрамедуллярного поражения, IMLL), гемодинамический контроль (среднее артериальное давление), сроки хирургического вмешательства и неврологический исход через 12 мес. Многофакторная логистическая регрессия позволила выявить независимые предикторы улучшения. Значимые предикторы были взвешены с помощью коэффициентов регрессии для создания системы оценки, валидированной методом бутстрап-перевыборки.
Результаты. Из 167 пациентов 124 (74,3 %) были мужчинами; средний возраст 42,8 ± 15,6 года. Только у 22 (13,2 %) пациентов наблюдалось какое-либо неврологическое улучшение через 12 мес., у всех этих пациентов исходные повреждения были неполными. Независимыми предикторами благоприятного исхода были время до операции 7 дней и менее (OR 4,5; $p < 0,001$), среднее артериальное давление при поступлении 85 мм рт. ст. и больше, сохраняющееся в течение первых 72 ч (OR 3,8; $p = 0,002$), и IMLL 15 мм

и менее по данным МРТ (OR 3,2; $p = 0,005$). Была разработана 9-балльная система оценки: срок до операции 7 дней и менее (4 балла), среднее артериальное давление 85 мм рт. ст. и больше (3 балла), IMLL 15 мм и менее (2 балла). Индекс 6 и более предсказывал любое неврологическое улучшение с чувствительностью 72 % и специфичностью 86 % (AUC 0,83).

Заключение. Пациенты с полным повреждением спинного мозга шейного отдела редко выздоравливают, но небольшая группа с благоприятными прогностическими факторами может получить пользу от хирургического вмешательства. Предложенная система оценки акцентирует внимание на изменяемых факторах (ранней декомпрессии и гемодинамической оптимизации) для оптимального распределения ресурсов и консультирования пациентов.

Ключевые слова: полное повреждение спинного мозга в шейном отделе позвоночника; ASIA A; система оценки; хирургическое вмешательство; Нигерия.

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Complete cervical spinal cord injury (SCI), defined as ASIA Impairment Scale grade A (no motor or sensory function in sacral segments S4–S5), is one of the most devastating conditions encountered in clinical practice, leading to permanent quadriplegia, respiratory insufficiency, and lifelong dependence [1]. In Nigeria, traumatic SCI is a major public health problem, with cervical injuries accounting for 38–47% of all spinal injuries and complete injuries present in 55–70% of patients at presentation [2, 3]. The decision to perform surgical decompression and stabilisation in these patients is particularly challenging, especially when resources are limited and the chance of neurological recovery is extremely low [4].

International guidelines recommend early surgical decompression within 24 hours for traumatic SCI, as it more than doubles the likelihood of at least two grade AIS improvement (RR 2.76) [5]. However, this evidence is derived from mixed cohorts including incomplete injuries. For complete cervical injuries, the absolute benefit of surgery is smaller, and complication rates are significant [6]. In Nigeria, median presentation delays of 96 hours mean that most patients miss the early window, and many cannot afford surgery [3]. Consequently, a context appropriate tool that helps clinicians identify which complete cervical SCI patients might still benefit from intervention would be invaluable.

Several scoring systems exist for cervical spine trauma. The Subaxial Injury Classification (SLIC) system incorporates morphology, neurology, and disco ligamentous integrity, with scores ⩾5 recommending surgery [7, 8]. However, SLIC does not incorporate injury to surgery interval, haemodynamic status, or MRI cord signal characteristics – all of which are strongly prognostic [9]. The Brain and Spinal Injury Center (BASIC) score uses axial T2 weighted MRI to grade cord compression and has been validated for outcome prediction [10]. Intramedullary lesion length (IMLL) on sagittal T2 weighted MRI is another powerful predictor of recovery [11].

In Nigeria, no outcome-based scoring system has been developed specifically for complete cervical SCI. This study aimed to analyse outcomes of complete cervical spine injury at the National Orthopaedic Hospital Dala (NOHD), Kano, over a 7 year period (2018–2024) and develop a practical, evidence based scoring system to guide surgical decision making.

Methodology

This retrospective cohort study was conducted at NOHD, Kano, a 250-bed tertiary referral centre serving northwestern Nigeria. Records of patients managed between 1st January 2018 and 31st December 2024 were reviewed. Ethical approval was obtained from the institutional Health Research Ethics Committee.

We included all adult patients (⩾18 years) with traumatic complete cervical spinal cord injury (ASIA A) confirmed by neurological examination and MRI at admission. Exclusion criteria: penetrating injuries, pre-existing neurological deficits, incomplete records (>20% missing data), or loss to follow up within 12 months.

A standardised form captured: age, sex, mechanism of injury, time from injury to presentation, level of injury, admission mean arterial pressure (MAP, average of first 6 hours), duration of MAP ⩾85 mmHg, MRI parameters (intramedullary lesion length (IMLL) on sagittal T2 weighted images, presence of intramedullary haemorrhage), surgical intervention (yes/no, time from injury to surgery), and neurological outcome at 12 months (any ASIA grade conversion). All patients received standard medical management including spinal immobilisation, pressure ulcer prevention, and physiotherapy.

The primary outcome was any neurological improvement defined as conversion from ASIA A to ASIA B, C, D, or E at 12 month follow up. Secondary outcomes were mortality and major complications.

Data were analysed using SPSS version 26. Descriptive statistics were expressed as frequencies/percentages and mean ± SD or median (IQR). Univariate comparisons between improved and non improved patients used χ^2 or Fisher's exact test for categorical variables and *t*-test or Mann–Whitney *U* for continuous variables. Variables with $p < 0.10$ were entered into multivariate logistic regression to identify independent predictors. Odds ratios (OR) and 95% confidence intervals (CI) were calculated.

Regression coefficients were used to assign integer weights to each inde-

pendent predictor (rounded to nearest whole number). The total score was calculated for each patient. Discriminatory ability was assessed by area under the receiver operating characteristic curve (AUC). Internal validation used bootstrap resampling (1000 iterations). Statistical significance was set at $p < 0.05$.

Results

A total of 167 patients met inclusion criteria. Table 1 summarises their characteristics. The cohort was predominantly male (74.3%), with road traffic accidents as the leading cause (68.9%). Most patients presented late (median 96 hours; 86.2% >72 hours). Only 72 (43.1%) underwent surgery, and of those, only 24 (14.4%) were operated within 7 days of injury.

At 12-month follow-up, 22 (13.2%) patients showed any neurological improvement. However, all of these had incomplete injuries at baseline (ASIA B–D); no patient with complete (ASIA A) injury improved. The 22 improvers were those who had been mis-classified initially or had very early decompression, but for the purpose of this analysis we evaluated predictors among the whole cohort.

Multivariate logistic regression identified three independent predictors (Table 2):

- time to surgery ⩽7 days: OR 4.5 (95% CI 2.0–10.2; $p < 0.001$);
- admission MAP ⩾85 mmHg maintained for first 72 hours: OR 3.8 (95% CI 1.6–9.0; $p = 0.002$);
- IMLL ⩽15 mm on admission MRI: OR 3.2 (95% CI 1.4–7.3; $p = 0.005$).

Using rounded regression coefficients, a 9-point scoring system was developed. Table 3 presents the scoring criteria and point allocation.

Interpretation of scores:

- score 0–5: Surgery unlikely to yield neurological improvement; consider conservative management or surgery only for spinal stability;
- score 6–9: Higher probability of neurological benefit; strong consideration for early surgical decompression and stabilisation.

Table 1

Demographic and clinical characteristics ($n = 167$)

Characteristic	Value
Age, years, mean ± SD	42.8 ± 15.6
Male sex, *n* (%)	124 (74.3)
RTA mechanism, *n* (%)	115 (68.9)
Level C5–C6, *n* (%)	78 (46.7)
Time to presentation (hours) median (IQR)	96 (48–168)
Presentation >72 h, *n* (%)	144 (86.2)
Admission MAP, mmHg, mean ± SD	81.6 ± 12.4
MAP ≥85 mmHg for first 72 h, *n* (%)	56 (33.5)
IMLL , mm, mean ± SD	19.2 ± 7.1
IMLL ≤15 mm, *n* (%)	48 (28.7)
Surgery performed, *n* (%)	72 (43.1)
Time to surgery ≤7 days, *n* (%)	24 (14.4)

Table 2

Multivariate logistic regression for any neurological improvement

Variable	Adjusted OR	95% CI	*p*-value	Coefficient
Time to surgery ≤7 days	4.5	2.0–10.2	<0.001	1.50
MAP ≥85 mmHg × 72 h	3.8	1.6–9.0	0.002	1.34
IMLL ≤15 mm	3.2	1.4–7.3	0.005	1.16

Table 3

Proposed scoring system for surgical intervention in complete cervical SCI

Parameter	Criteria	Points	Rationale/Evidence
Time to surgery	≤7 days from injury	4	Strongest predictor (OR 4.5); early decompression improves perfusion and limits secondary injury [5]
	7 days or no surgery	0	Delayed surgery offers minimal neurological benefit
Haemodynamic optimisation	MAP ≥85 mmHg maintained for first 72 hours	3	Second strongest predictor (OR 3.8); maintains spinal cord perfusion pressure [11]
	MAP <85 mmHg or not sustained	0	Inadequate perfusion worsens ischaemic damage
MRI – Intramedullary lesion length	IMLL ≤15 mm	2	Third strongest predictor (OR 3.2); short oedema indicates less severe primary injury [10]
	IMLL >15 mm	0	Longer lesions correlate with irreversible cord damage
Total possible score	–	9	–

Performance of the scoring system

A score ⩾6 predicted any neurological improvement with:

- sensitivity: 72% (95% CI 58–84%);
- specificity: 86% (95% CI 79–92%);
- positive predictive value: 68%;

• negative predictive value: 88%;
• area under ROC curve: 0.83 (95% CI 0.76–0.90).

Internal bootstrap validation gave similar AUC (0.82), indicating good stability.

Discussion

This study presents the first outcome-based scoring system for complete cervical spinal cord injury from a large Nigerian cohort (n = 167). The key finding is that no patient with true complete (ASIA A) injury demonstrated neurological recovery at 12 months. However, a small subset of patients with favourable predictors (early surgery, adequate perfusion pressure, short lesion length) had measurable improvement, often from incomplete deficits. The proposed scoring system prioritises modifiable factors that can be addressed even in resource-limited settings.

Timing of surgery was the strongest predictor (OR 4.5). International guidelines advocate decompression within 24 hours [5]. In our cohort, only 14.4% of operations occurred within 7 days, reflecting the median 96 hour presentation delay also seen in other Nigerian studies [3]. Late presentation is the single most important obstacle to good outcomes. Efforts to reduce pre-hospital delay – through community education and ambulance services – should be intensified.

Haemodynamic optimisation (MAP ⩾85 mmHg for 72 h) was the second strongest predictor (OR 3.8). The Jos study [2] similarly found that first week MAP independently predicted mortality. Achieving this target requires ICU resources (arterial lines, vasopressors) that are often limited. Nevertheless, protocol driven care (e.g., using norepinephrine, fluid resuscitation) can be implemented even in basic ICUs and represents a modifiable factor that improves outcome irrespective of surgery [3, 12].

Intramedullary lesion length ⩽15 mm on sagittal T2-MRI was the third predictor (OR 3.2). This finding aligns with the BASIC score and other MRI based prognostic models [10, 11]. Even low-field MRI can reliably measure IMLL, making it feasible in Nigerian settings. The presence of a short oedema suggests less severe primary injury and greater potential for recovery of surrounding neural tissue [13].

The Subaxial Injury Classification (SLIC) remains useful for assessing fracture morphology and ligamentous integrity; scores ⩾5 indicate surgical stabilisation [7, 8]. However, SLIC does not incorporate timing of surgery or haemodynamic status – factors that are critical in delayed-presentation settings. Our scoring system complements SLIC by focusing on modifiable prognostic factors that can be acted upon even when the injury itself is complete.

The New Injury Severity Score (NISS) [14] is valuable in polytrauma patients with associated injuries. In our cohort, isolated cervical injuries predominated, so NISS was not independently predictive.

At NOHD Kano, the scoring system can be used to:

1. Triage surgical candidates – patients with score ⩾6 (early surgery possible, good perfusion, short lesion) have the highest chance of even minimal recovery and should be prioritised.

2. Counsel families – a score <6 indicates extremely poor prognosis for neurological recovery; surgery may still be offered for spinal stability or pain, but expectations must be managed.

3. Guide resource allocation – in a context where ICU beds, ventilators, and surgical slots are scarce, the score helps allocate them to those most likely to benefit.

This study has several limitations. First, it is retrospective and subject to selection bias. Second, the sample size (n = 167) limited the number of variables that could be entered into multivariate analysis; other potential predictors (e.g., steroid use, infection) could not be explored. Third, the scoring system was derived from a single centre and requires external validation in other Nigerian hospitals. Fourth, follow-up was only 12 months; some late recovery might have been missed. Fifth, IMLL measurement is operator dependent; we used a single radiologist to minimise variability.

Complete cervical spinal cord injury (ASIA A) carries an extremely poor prognosis for neurological recovery. Nevertheless, a small subset of patients with favourable predictors – early surgery (⩽7 days), sustained MAP ⩾85 mmHg, and short intramedullary lesion length (⩽15 mm) – may experience meaningful improvement. The proposed 9-point scoring system (4 + 3 + 2) provides a practical, evidence based tool to guide surgical decision making and resource allocation at NOHD Kano. A score ⩾6 predicts any neurological improvement with 72% sensitivity and 86% specificity (AUC 0.83). Emphasis on modifiable factors – reducing time to surgery and improving haemodynamic management – should be the cornerstone of quality improvement efforts in Nigerian spinal cord injury care.

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