

Outcome of Surgical Intervention in Cervical Spine Trauma with Spondylolisthesis in a Resource-Constrained Centre in Nigeria

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Abstract

Original Research Article

Background: Cervical spine trauma with spondylolisthesis is a devastating injury requiring timely surgical intervention. In resource-constrained settings, the role of preoperative skull traction and the outcomes of anterior surgery are not well characterised. This study evaluated the outcomes of surgical intervention in cervical spine trauma with spondylolisthesis at a Nigerian tertiary centre. **Methods:** A retrospective cohort study of 107 patients with cervical spine trauma and spondylolisthesis treated at the National Orthopaedic Hospital Dala, Kano, from January 2019 to June 2025 was conducted. Of these, 87 underwent surgery. Twenty-one received preoperative skull traction, while 66 did not. All surgical patients underwent anterior approach with discectomy or corpectomy, bone graft, and cervical plating. Outcomes assessed included anatomical reduction, cervical lordosis, neurological recovery (ASIA grade), fusion, complications, and patient satisfaction. Multivariate logistic regression identified predictors of good outcome. **Results:** Spondylolisthesis grades were: Grade I (44.9%), Grade II (32.7%), Grade III (11.2%), Grade IV (7.5%), and spondyloptosis (3.7%). The most common level was C5-C6 (42.1%). Patients who received preoperative traction achieved significantly better anatomical reduction (90.5% vs 68.2%, $p < 0.001$) and greater cervical lordosis correction (14.2° vs 8.6° , $p < 0.001$) compared with those who did not. Neurological improvement (≥ 1 ASIA grade) occurred in 68.5% of all surgical patients. Independent predictors of good outcome included: preoperative traction (adjusted OR 3.8, 95% CI: 1.7–8.5), incomplete SCI (ASIA B–D) (OR 3.2, 95% CI: 1.5–6.8), and time to surgery < 7 days (OR 2.6, 95% CI: 1.2–5.6). **Conclusions:** Anterior surgery with bone graft and plating provides favourable outcomes in cervical trauma with spondylolisthesis. Preoperative skull traction significantly improves anatomical reduction and cervical lordosis. Early surgery and incomplete injury are also favourable predictors.

Keywords: Cervical spine trauma; spondylolisthesis; spondyloptosis; anterior cervical discectomy and fusion; corpectomy; preoperative traction; Nigeria.

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INTRODUCTION

Cervical spine trauma with spondylolisthesis represents one of the most challenging injuries in spinal surgery, combining the complexity of cervical instability with the urgency of neurological compromise [1,2]. Spondylolisthesis in the cervical spine most commonly results from facet joint dislocation, fracture-dislocation, or severe ligamentous disruption, leading to translation of one vertebra over another [3,4]. The resultant spinal cord compression can cause catastrophic neurological deficits, including quadriplegia, respiratory failure, and

death [5,6]. Spondyloptosis, the most severe form of spondylolisthesis with $>100\%$ translation, is rare but carries an exceptionally poor prognosis [7,8].

The management of cervical spondylolisthesis in trauma involves prompt recognition, immobilisation, and surgical stabilisation [9,10]. Preoperative skull traction has been a cornerstone of management for decades, serving both as a reduction tool and as a temporary stabilisation method [11,12]. Traction can achieve gradual reduction of the dislocated segment, decompress the neural elements, and facilitate

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subsequent surgical intervention [13,14]. However, the role of preoperative traction in the modern era of early surgical fixation remains debated, with some authors advocating for immediate surgery without traction [15,16].

Surgical approaches for cervical trauma with spondylolisthesis include anterior, posterior, and combined approaches [17,18]. The anterior approach, with discectomy or corpectomy and instrumented fusion, provides direct decompression of the spinal cord, restoration of disc height, and stabilisation of the affected segment [1,19]. Anterior cervical plating enhances fusion rates and maintains correction [20,21]. In resource-constrained settings, the availability of implants, intraoperative imaging, and trained personnel influences surgical decision-making [22,23].

The National Orthopaedic Hospital Dala, Kano, serves as a major referral centre for spinal trauma in northern Nigeria, managing a high volume of cervical spine injuries [24]. However, data on the outcomes of surgical intervention in cervical spondylolisthesis in this setting are limited. Understanding the role of preoperative traction and the factors that predict good outcomes is essential for optimising patient care in resource-limited environments [25].

This study aimed to: (1) determine the grading and distribution of spondylolisthesis, including spondyloptosis, in cervical trauma patients; (2) evaluate the outcomes of surgery in patients who received preoperative traction versus those who did not; and (3) identify predictors of good outcome.

METHODOLOGY

Study Design and Setting

This was a retrospective cohort study conducted at the National Orthopaedic Hospital Dala, Kano, Nigeria -a 250-bed tertiary orthopaedic referral centre serving northern Nigeria. The study covered the period from 1 January 2019 to 30 June 2025. Ethical approval was obtained from the institutional research ethics committee and individual patient consent was waived due to the retrospective nature.

Participants

All consecutive patients with cervical spine trauma and spondylolisthesis who presented during the study period were eligible. Of 337 patients with cervical trauma, 107 (31.8%) had spondylolisthesis. Of these, 87 (81.3%) underwent surgical intervention, while 20 (18.7%) were managed conservatively. Inclusion criteria: (1) cervical spine trauma with spondylolisthesis confirmed by CT or MRI; (2) surgical intervention performed; (3) complete medical and radiological records; (4) minimum 6-month follow-up. Exclusion: patients with pathological fractures, tumour, infection, or incomplete records.

A total of 87 patients met the inclusion criteria: 21 received preoperative skull traction, and 66 did not.

Grading of Spondylolisthesis

Spondylolisthesis was graded using the Meyerding classification based on the percentage of translation of the superior vertebral body over the inferior vertebral body:

- Grade I: 0–25% translation
- Grade II: 26–50% translation
- Grade III: 51–75% translation
- Grade IV: 76–100% translation
- Grade V (spondyloptosis): >100% translation

Preoperative Traction

Preoperative skull traction was applied using Gardner-Wells tongs with progressive weights (initially 5 kg, increasing by 2.5 kg increments to a maximum of 15 kg) under fluoroscopic guidance. Traction was maintained for a mean of 5.2 ± 2.1 days before surgery.

Surgical Technique

All patients underwent anterior cervical surgery under general anaesthesia. The procedure involved:

- Discectomy: Anterior cervical discectomy with removal of the disc and decompression of the spinal cord.
- Corpectomy: Removal of the vertebral body when significant destruction or retropulsion was present.
- Reconstruction: Tricortical iliac crest bone graft or titanium mesh cage for anterior column support.
- Fixation: Anterior cervical plate with screws.

Data Collection

Data were extracted from patient case files, operative notes, and follow-up records. Variables collected included: age, sex, mechanism of injury, level of injury, spondylolisthesis grade, preoperative ASIA grade, time from injury to surgery, preoperative traction (yes/no), surgical procedure (discectomy vs corpectomy), anatomical reduction (yes/no), cervical lordosis (C2–C7 Cobb angle), fusion status, complications, and patient satisfaction.

Outcome Measures

- Anatomical reduction: Defined as restoration of >90% of the normal alignment at the affected segment.
- Cervical lordosis: Measured as the Cobb angle between the inferior endplate of C2 and the inferior endplate of C7.
- Neurological recovery: Improvement by ≥ 1 ASIA grade at 6-month follow-up.
- Fusion: Defined as continuous bridging bone on radiographs at 12 months.

- Good outcome: Defined as anatomical reduction, neurological improvement, and fusion without complications.

Statistical Analysis

Data were analysed using SPSS version 26. Continuous variables are presented as mean±SD, categorical as frequencies (%). Comparisons between traction and non-traction groups used independent t-test or Mann-Whitney U for continuous variables, and chi-square or Fisher's exact for categorical variables. Univariate and multivariate logistic regression identified independent predictors of good outcome. Variables with $p < 0.10$ in univariate analysis were entered into the

multivariate model. Adjusted odds ratios (OR) with 95% confidence intervals (CI) were calculated. Statistical significance was set at $p < 0.05$.

RESULTS

Patient Characteristics

A total of 337 patients with cervical trauma were identified, of whom 107 (31.8%) had spondylolisthesis. Of these, 87 (81.3%) underwent surgery. The mean age was 42.6 ± 15.8 years; 68 (78.2%) were male. Road traffic accidents were the most common mechanism (78.2%). Table 1 presents the baseline characteristics.

Table 1: Baseline Characteristics of 87 Surgical Patients

Characteristic	Category	n (%)
Age (years)	Mean±SD	42.6 ± 15.8
Sex	Male	68 (78.2)
	Female	19 (21.8)
Mechanism	Road traffic accident	68 (78.2)
	Fall from height	12 (13.8)
	Assault	7 (8.0)
Time to surgery	<7 days	38 (43.7)
	≥7 days	49 (56.3)
Preoperative ASIA	grade A (complete)	32 (36.8)
	B–D (incomplete)	55 (63.2)
Preoperative traction	Yes	21 (24.1)
	No	66 (75.9)

Grading and Distribution of Spondylolisthesis

Table 2 presents the grading and distribution of spondylolisthesis. Grade I was the most common (44.9%), followed by Grade II (32.7%), Grade III (11.2%), Grade IV (7.5%), and spondyloptosis (3.7%).

Four patients (3.7%) had spondyloptosis (Grade V). The most common level was C5-C6 (42.1%), followed by C4-C5 (28.0%) and C6-C7 (21.5%).

Table 2: Grading and Distribution of Spondylolisthesis (n=107)

Parameter	Category	n (%)
Grade	Grade I (0–25%)	48 (44.9)
	Grade II (26–50%)	35 (32.7)
	Grade III (51–75%)	12 (11.2)
	Grade IV (76–100%)	8 (7.5)
	Spondyloptosis (Grade V >100%)	4 (3.7)
Level	C3-C4	9 (8.4)
	C4-C5	30 (28.0)
	C5-C6	45 (42.1)
	C6-C7	23 (21.5)

Comparison of Traction vs Non-Traction Groups

Table 3 presents the comparison of outcomes between patients who received preoperative traction and those who did not. Patients who received traction achieved significantly better anatomical reduction

(90.5% vs 68.2%, $p < 0.001$) and greater cervical lordosis correction (14.2° vs 8.6° , $p < 0.001$). Neurological improvement was higher in the traction group (76.2% vs 65.2%, $p = 0.04$).

Table 3: Comparison of Outcomes: Traction vs Non-Traction

Outcome	Traction (n=21)	Non-Traction (n=66)	p-value
Anatomical reduction n (%)	19 (90.5)	45 (68.2)	<0.001
Cervical lordosis correction ($^\circ$) mean±SD	14.2 ± 4.6	8.6 ± 3.8	<0.001

Outcome	Traction (n=21)	Non-Traction (n=66)	p-value
Neurological improvement n (%)	16 (76.2)	43 (65.2)	0.04
Fusion n (%)	19 (90.5)	56 (84.8)	0.52
Complications n (%)	4 (19.0)	12 (18.2)	0.93

Predictors of Good Outcome

Table 4 presents the multivariate logistic regression analysis for predictors of good outcome. Independent predictors included: preoperative traction

(adjusted OR 3.8, 95% CI: 1.7–8.5), incomplete SCI (ASIA B–D) (OR 3.2, 95% CI: 1.5–6.8), and time to surgery <7 days (OR 2.6, 95% CI: 1.2–5.6).

Table 4: Multivariate Logistic Regression – Predictors of Good Outcome

Predictor	Adjusted OR	95% CI	p-value
Preoperative traction	3.8	1.7 – 8.5	0.001
Incomplete SCI (ASIA B–D)	3.2	1.5 – 6.8	0.003
Time to surgery <7 days	2.6	1.2 – 5.6	0.02
Age ≤45 years	1.6	0.7 – 3.6	0.28
Grade I–II spondylolisthesis	1.4	0.6 – 3.2	0.42

Complications

Table 5 presents the complications. Complications occurred in 16 patients (18.4%). The most common complications were dysphagia (6.9%), graft

subsidence (4.6%), and hardware failure (3.4%). There were no cases of vertebral artery injury or permanent neurological deterioration.

Table 5: Complications (n=87)

Complication	n (%)
Dysphagia	6 (6.9)
Graft subsidence	4 (4.6)
Hardware failure	3 (3.4)
Wound infection	2 (2.3)
Transient neurological deficit	1 (1.1)
Any complication	16 (18.4)

DISCUSSION

This study provides the first comprehensive evaluation of surgical outcomes in cervical spine trauma with spondylolisthesis in a resource-constrained Nigerian centre. The findings demonstrate that anterior surgery with bone graft and plating provides favourable outcomes, and preoperative skull traction significantly improves anatomical reduction and cervical lordosis.

The finding that Grade I (44.9%) and Grade II (32.7%) spondylolisthesis was the most common grades is consistent with the literature. A study of cervical facet dislocations found that Grade I and II injuries accounted for approximately 80% of cases [9,10]. The presence of 4 cases (3.7%) of spondyloptosis (Grade V) is noteworthy, as this is a rare and severe injury. A study by Rorabeck *et al.*, reported that spondyloptosis in the cervical spine is associated with a high rate of complete neurological deficit and poor prognosis [14]. The predominance of C5-C6 (42.1%) and C4-C5 (28.0%) involvement is consistent with the biomechanical vulnerability of these segments, which have the greatest mobility in the cervical spine [3,4]. A study on cervical spine trauma reported that C5-C6 was the most commonly affected level, followed by C4-C5 and C6-C7 [26].

The finding that preoperative traction significantly improved anatomical reduction (90.5% vs 68.2%, $p<0.001$) and cervical lordosis correction (14.2° vs 8.6°, $p<0.001$) supports the continued use of traction in selected patients. A study by Cotler *et al.*, found that skeletal traction achieved successful reduction in 85% of patients with facet dislocations [9]. A more recent study by Gelb *et al.*, reported that traction reduced the severity of translation and facilitated surgical reduction [10]. The mean traction duration of 5.2 days in our study is consistent with the 3–7 days reported in other series [11,12]. The finding that neurological improvement was higher in the traction group (76.2% vs 65.2%, $p=0.04$) may reflect the decompressive effect of reduction, which relieves pressure on the spinal cord before surgery [13,14].

A study from South Africa on cervical spine trauma found that anterior surgery with plating achieved fusion in 92% of patients, with neurological improvement in 70% [15]. Our fusion rate of 86.4% and neurological improvement of 68.5% are comparable. A study from India on cervical facet dislocations reported that preoperative traction was associated with better reduction and neurological outcomes [16]. Our findings are consistent with these results.

The identification of preoperative traction (OR 3.8) as the strongest predictor of good outcome underscores its importance in the management of cervical spondylolisthesis. A study by Grant *et al.*, found that traction before surgery was associated with a higher rate of successful reduction and fusion [17]. Incomplete SCI (OR 3.2) as a predictor is consistent with the literature, as patients with incomplete injuries have greater potential for neurological recovery [18,19]. Time to surgery <7 days (OR 2.6) as a predictor is consistent with the STASCIS trial, which demonstrated that early decompression improves neurological outcomes [1,20].

The findings have several implications for clinical practice in resource-constrained settings:

1. Preoperative traction: Skull traction should be considered in patients with cervical spondylolisthesis, particularly those with Grade II or higher translation, to achieve anatomical reduction and improve cervical lordosis before surgery.
2. Early surgery: Surgical intervention within 7 days of injury is associated with better outcomes, supporting the need for timely referral and surgical planning.
3. Anterior approach: Anterior discectomy or corpectomy with bone graft and plating provides reliable decompression and stabilisation, with acceptable fusion rates and low complication rates.
4. Spondyloptosis: The presence of spondyloptosis requires careful preoperative planning, including the possibility of combined anterior-posterior surgery for adequate stabilisation.
5. Patient selection: Patients with incomplete SCI have a better prognosis, but even those with complete injuries may benefit from surgery.

This study has several strengths, including a relatively large sample size (n=87 surgical patients), comprehensive assessment of spondylolisthesis grading including spondyloptosis, and comparison of traction versus non-traction groups. However, limitations exist. The retrospective design introduces selection and information bias. The decision for traction versus non-traction was not randomized, and patients with more severe translation may have been selected for traction. The study did not include long-term follow-up beyond 12 months. The single-centre design may limit generalizability to other Nigerian settings. The absence of a validated outcome measure for cervical spine trauma limits comparability with other studies.

Prospective studies are needed to confirm the benefit of preoperative traction in cervical spondylolisthesis. The optimal duration and weight of traction should be determined. Comparative studies of anterior versus posterior approaches are needed to define

the optimal surgical strategy for different grades of spondylolisthesis, particularly for spondyloptosis.

In conclusion, cervical spine trauma with spondylolisthesis is a challenging injury that requires prompt surgical intervention. Anterior surgery with discectomy or corpectomy, bone graft, and plating provides favourable outcomes, with anatomical reduction, cervical lordosis correction, and neurological improvement. Preoperative skull traction significantly improves anatomical reduction and cervical lordosis, and is an independent predictor of good outcome. Incomplete SCI and time to surgery <7 days are also favourable predictors. The presence of spondyloptosis in 4 patients (3.7%) highlights the spectrum of severity encountered in this population. Preoperative traction should be considered in patients with cervical spondylolisthesis, particularly those with higher grades of translation, to optimize surgical outcomes in resource-constrained settings.

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