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Research Article

Outcome of Lateral Mass Screw Fixation in Traumatic Cervical Spine Injury at the National Orthopaedic Hospital, Dala, Kano, Nigeria

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Abstract

Background: Traumatic cervical spine injuries are associated with significant morbidity and mortality, often requiring surgical stabilization to prevent neurological deterioration and maintain alignment. Lateral mass screw fixation has emerged as a reliable technique for posterior cervical stabilization. This study evaluates the clinical and radiological outcomes of lateral mass screw fixation in patients with traumatic subaxial cervical spine injuries at the National Orthopaedic Hospital (NOH), Dala, Kano, Nigeria.

Methods: A retrospective cohort study was conducted on patients who underwent posterior lateral mass screw fixation for traumatic cervical spine injuries (C3-C7) between January 2019 and December 2024 at NOH, Dala. Data extracted included demographics, mechanism of injury, levels instrumented, neurological status using Frankel grading, operative details, complications and fusion rates. Outcomes were assessed preoperatively and at 6 and 12 months postoperatively.

Results: A total of 48 patients (38 males, 10 females) with a mean age of 41.2 ± 12.8 years (range: 19-68 years) underwent lateral mass screw fixation. Road traffic accidents were the predominant mechanism (81.3%). The most common level of injury was C5-C6 (47.9%). Mean operative time was 168 ± 42 minutes and mean blood loss was 320 ± 140 mL. At 12 months, 32 of 48 patients (66.7%) showed neurological improvement by at least one Frankel grade, with 12 patients (25.0%) achieving complete neurological recovery (Grade E). Fusion was achieved in 44 patients (91.7%). Complications occurred in 8 patients (16.7%), including superficial wound infection (6.3%), transient C5 radiculopathy (4.2%), screw malposition requiring revision (2.1%) and implant failure (2.1%). There was no vertebral artery injury or perioperative mortality.

Conclusion: Lateral mass screw fixation for traumatic cervical spine injuries at NOH, Dala, demonstrates favourable neurological recovery, high fusion rates and acceptable complication rates, comparable to international series. These findings support the continued use of this technique in Nigerian tertiary centres for managing unstable subaxial cervical trauma.

Keywords: Lateral Mass Screw; Cervical Spine Injury; Subaxial Cervical Spine; Spinal Trauma; Posterior Stabilization; Nigeria

Introduction

Cervical spine injuries represent a significant proportion of spinal trauma, with the subaxial cervical spine (C3-C7) being the most frequently involved region due to its high mobility and biomechanical vulnerability [1]. These injuries often result from high-energy mechanisms such as road traffic accidents, falls from height and sports-related impacts, leading to instability, neurological deficits and substantial socioeconomic burden [2]. In Nigeria, road traffic accidents remain a leading cause of morbidity and mortality, with cervical spine injuries constituting a considerable proportion of trauma admissions in tertiary centres [3].

The management of unstable cervical spine injuries aims to achieve neural decompression, restore spinal alignment and provide stable fixation to facilitate early mobilisation and rehabilitation [4]. Surgical options include anterior, posterior or combined approaches, with the choice depending on injury morphology, neurological status and surgeon preference [5]. Posterior stabilization using lateral mass screw fixation has gained widespread acceptance since its popularization by Roy-Camille and Magerl, offering three-column stability, high fusion rates and versatility for multilevel pathologies [6,7].

Lateral mass screws provide biomechanical advantages over alternative posterior techniques such as wiring, with superior pullout strength and rigidity [8]. The technique is particularly suitable for the subaxial cervical spine, where pedicle dimensions may preclude safe pedicle screw placement [9]. Multiple international studies have demonstrated excellent clinical outcomes with lateral mass screw fixation, with neurological improvement rates ranging from 58% to 89% and fusion rates exceeding 90% [10-12].

In Nigeria, posterior spinal stabilization has been described for various indications, including trauma and degenerative conditions [13]. However, specific outcome data for lateral mass screw fixation in traumatic cervical spine injuries from Nigerian tertiary centres remain limited. The National Orthopaedic Hospital (NOH), Dala, Kano, established in 1959, is one of Nigeria's three specialised orthopaedic tertiary institutions and serves as a major referral centre for northern Nigeria [14]. The hospital has developed capacity for complex spinal surgery, with a dedicated Spine Unit managing a high volume of trauma cases [15].

This study aims to evaluate the clinical and radiological outcomes of lateral mass screw fixation in patients with traumatic subaxial cervical spine injuries at NOH, Dala, Kano, over a six-year period, providing the largest reported series from northern Nigeria.

Methodology

This was a retrospective cohort study conducted at the National Orthopaedic Hospital, Dala, Kano, Nigeria. The hospital is a 450-bed federal tertiary institution specialising in musculoskeletal disorders, with a catchment area covering Kano State and neighbouring northern Nigerian states [14]. Data were collected for all patients who underwent posterior lateral mass screw fixation for traumatic cervical spine injuries between 1st January 2019 and 31st December 2024 (six-year period).

All patients aged 18 years and above who underwent posterior lateral mass screw fixation for unstable subaxial cervical spine injuries (C3-C7) confirmed radiologically were eligible for inclusion. Exclusion criteria were: (1) patients with injuries involving C1-C2; (2) patients with pathological fractures due to tumours or infections; (3) patients with previous cervical spine surgery; (4) patients with incomplete medical records; and (5) patients lost to follow-up before the minimum 12-month postoperative assessment.

Medical records, operative logbooks and clinic follow-up notes were reviewed by two independent researchers using a standardised data extraction form. Data collected included:

1. Demographic characteristics: Age, sex, occupation and mechanism of injury.
2. Clinical presentation: Neurological status using Frankel grading [16], associated injuries and time from injury to surgery.
3. Radiological findings: Level(s) of injury, fracture morphology and presence of subluxation or dislocation.
4. Surgical details: Date of surgery, levels instrumented, number of screws placed, operative time, intraoperative blood loss and intraoperative complications.
5. Outcome measures: Neurological status using Frankel grading assessed preoperatively and at 6 and 12 months postoperatively; fusion status assessed on plain radiographs (flexion-extension views) at 12 months using Bridwell criteria [17]; pain severity using Visual Analogue Scale (VAS; 0-10) at same intervals; and complications (surgical site infection, implant-related complications, neurological deterioration, reoperation, mortality).

All patients underwent posterior cervical stabilization under general anaesthesia. Patients were positioned prone on a radiolucent table with the head secured in a Mayfield clamp or on a horseshoe headrest with careful neck alignment. A midline posterior incision was made and the lateral masses were exposed through subperiosteal dissection. Screw insertion points were identified using the Magerl technique (1 mm medial and superior to the centre of the lateral mass, with screw trajectory directed 25° laterally and parallel to the facet joint) [6] or the Anderson technique [18] depending on surgeon preference. Pilot holes were

drilled under fluoroscopic guidance, tapped and polyaxial screws (3.5 mm diameter, 12-16 mm length) were inserted. Precontoured titanium rods were secured and decorticated bone graft (local autograft or iliac crest) was placed for fusion. Wound closure was performed over a drain.

Postoperatively, patients were immobilised in a rigid cervical collar for 6-8 weeks and commenced physiotherapy as tolerated. Ethical approval was obtained and due to the retrospective nature of the study, the requirement for individual patient consent was waived. Patient confidentiality was maintained through anonymised data collection and secure storage.

Data were entered into Microsoft Excel (Version 16.0) and analysed using SPSS for Windows (Version 25.0, IBM Corp., Armonk, NY). Descriptive statistics (frequencies, percentages, means, standard deviations, ranges) were calculated for all variables. Paired t-tests were used to compare preoperative and postoperative VAS scores. Statistical significance was set at $p < 0.05$.

Results

A total of 58 patients underwent lateral mass screw fixation for traumatic cervical spine injuries during the study period. After applying inclusion and exclusion criteria, 48 patients were included in the final analysis (10 excluded: 6 with incomplete records, 4 lost to follow-up). Table 1 presents the demographic and clinical characteristics. The mean age was 41.2 ± 12.8 years (range: 19-68 years). There was a strong male predominance (79.2%), consistent with trauma demographics globally [10,19]. Road traffic accidents were the predominant mechanism (81.3%), reflecting the high burden of motor vehicle collisions in Nigeria [3]. The most common level of injury was C5-C6 (47.9%), consistent with the biomechanical vulnerability of this segment [1]. Mean time from injury to surgery was 8.4 ± 4.6 days (range: 2-21 days).

Table 2 summarises the surgical procedures and intraoperative parameters. Mean operative time was 168 ± 42 minutes (range: 110-280 minutes). Mean intraoperative blood loss was 320 ± 140 mL (range: 150-800 mL). Blood transfusion was required in 8 patients (16.7%). Mean length of hospital stay was 10.2 ± 4.8 days (range: 5-24 days). A total of 248 lateral mass screws were placed, with a mean of 5.2 ± 1.1 screws per patient. The Magerl technique was used in 66.7% of patients. Laminectomy for decompression was performed in 58.3% of cases.

Table 3 presents neurological status using Frankel grading preoperatively and at 12 months. Of 44 patients with preoperative neurological deficits (Frankel A-D), 32 (72.7%) improved by at least one Frankel grade at 12 months. Complete neurological recovery (Frankel E) was achieved in 12 patients (25.0% of the total cohort, 27.3% of those with deficits). Patients with incomplete deficits (Frankel C or D) showed greater improvement than those with complete deficits (Frankel A or B). This neurological improvement rate is comparable to the 58-62% reported in recent series [10,11] and the 66.7% reported in our earlier analysis. Mean VAS improved from 7.6 ± 1.5 preoperatively to 2.8 ± 1.2 at 12 months ($p < 0.001$), representing a 63.2% reduction in pain scores. This exceeds the minimal clinically important difference of 2 points [20].

Fusion was achieved in 44 patients (91.7%) at 12 months. Four patients (8.3%) had delayed union but achieved fusion by 18 months with continued bracing. There were no cases of symptomatic pseudarthrosis requiring revision. Postoperative imaging demonstrated satisfactory screw position in 46 patients (95.8%), with two patients (4.2%) having screw malposition (one asymptomatic, one requiring revision).

Table 4 details complications encountered in the study population. Overall, 8 patients (16.7%) experienced one or more complications. This rate is comparable to the 15-19% reported in international series [12,21]. Transient C5 radiculopathy (4.2%) resolved with conservative management in all cases. There were no vertebral artery injuries, nerve root injuries requiring reoperation or perioperative mortality.

Characteristic	Number(n)	Percentage (%)
Gender		
Male	38	79.2%
Female	10	20.8%
Age group (years)		

18-30	12	25.0%
31-40	16	33.3%
41-50	12	25.0%
51-60	6	12.5%
>60	2	4.2%
Mechanism of injury		
Road traffic accident	39	81.3%
Fall from height	6	12.5%
Assault	2	4.2%
Sports injury	1	2.1%
Level of injury		
C3-C4	6	12.5%
C4-C5	10	20.8%
C5-C6	23	47.9%
C6-C7	9	18.8%
Injury type		
Fracture-dislocation	22	45.8%
Burst fracture	14	29.2%
Facet dislocation	8	16.7%
Compression fracture	4	8.3%

Table 1: Demographic and clinical characteristics of 48 patients undergoing lateral mass screw fixation.

Characteristic	Number (n)	Percentage (%)
Number of levels instrumented		
1 level	8	16.7%
2 levels	22	45.8%
3 levels	14	29.2%
≥ 4 levels	4	8.3%
Screw insertion technique		
Magerl technique	32	66.7%
Anderson technique	16	33.3%
Screw distribution		
Total screws placed	248 —	
Mean screws per patient	5.2 ± 1.1 —	
Concomitant procedures		
Laminectomy	28	58.3%
Foraminotomy	12	25.0%

Table 2: Surgical characteristics of 48 patients.

Frankel Grade	Preoperative (n)	12 Months Postoperative (n)
A (Complete motor/sensory loss)	8	4
B (Sensory only no motor)	12	6
C (Motor useless)	14	8
D (Motor useful)	10	18
E (Normal)	4	12
Total	48	48

Table 3: Neurological status (Frankel Grade) preoperatively and at 12 months.

Complication	Number (n)	Percentage (%)
Intraoperative complications		
Dural tear	2	4.2%
Excessive blood loss (>800 mL)	2	4.2%
Postoperative complications		
Superficial surgical site infection	3	6.3%
Transient C5 radiculopathy	2	4.2%
Screw malposition (symptomatic)	1	2.1%
Implant failure (screw pullout)	1	2.1%
Respiratory infection	4	8.3%
Urinary tract infection	3	6.3%
Reoperations		
For screw revision	1	2.1%
For wound debridement	1	2.1%
Mortality (30-day)	0	0%

Table 4: Complications following lateral mass screw fixation.

Discussion

This study represents the largest reported series of lateral mass screw fixation for traumatic cervical spine injuries from northern Nigeria, encompassing 48 patients over a six-year period. The findings demonstrate that posterior lateral mass screw fixation achieves significant neurological improvement, high fusion rates and acceptable complication rates, comparable to international published series.

The mean age of 41.2 years and male predominance (79.2%) in this series are consistent with global trauma demographics. Rehman, et al., reported mean age of 32 years with 68.2% males in their Pakistani series of 88 patients [10]. Zia-Ur-Rahman, et al., reported mean age of 36.9 years with 80% males in their Bangladeshi series of 100 patients [19]. The predominance of road traffic accidents (81.3%) as the mechanism of injury reflects the high burden of motor vehicle collisions in Nigeria, where road traffic fatalities remain among the highest in Africa [3].

The most common level of injury was C5-C6 (47.9%), consistent with the biomechanical vulnerability of this segment as the transition zone between the relatively mobile lower cervical spine and the more rigid upper thoracic spine [1]. This finding aligns with Rehman, et al., who reported C5-C6 involvement in 52% of their patients [10].

Neurological improvement in 72.7% of patients with preoperative deficits is excellent and comparable to international series. Ali, et al., reported 62% improvement at 6 months in their Indian series of 50 patients [11]. Rehman, et al., reported 58% improvement and 42% power improvement in their Pakistani series [10]. The higher improvement rate in our series may reflect differences in patient selection, timing of surgery or rehabilitation protocols.

Complete neurological recovery (Frankel E) was achieved in 25.0% of patients, comparable to the 20% reported by Ali, et al., and the 29.6% reported by Rehman, et al. [10,11]. Patients with incomplete deficits (Frankel C or D) showed greater improvement than those with complete deficits, underscoring the importance of early surgical intervention before irreversible cord damage occurs [22].

The fusion rate of 91.7% at 12 months is comparable to the 88% reported by Ali, et al., and the 90-96% rates reported in other series [11,12,23]. The use of autologous bone graft in all patients contributed to this high fusion rate, avoiding the expense and availability issues associated with allograft or synthetic substitutes in our setting [15].

The mean operative time (168 minutes) and blood loss (320 mL) in this series are favourable compared to other studies. Ali et al. reported mean operative time of 180 minutes while Pateder, et al., reported mean blood loss of 300-400 mL [11,21]. These parameters reflect the learning curve and experience of the surgical team at NOH, Dala.

The outcomes of this series compare favourably with published international data. A systematic review by Coe, et al., reported neurological improvement rates of 65-85% and fusion rates exceeding 90% for lateral mass screw fixation [12]. Al Barbarawi and Allouh reported on 2500 consecutive screws with 94% excellent clinical outcomes and 2.4% complication rate [24]. Our results are consistent with these studies, confirming that lateral mass screw fixation is effective across diverse populations and healthcare settings.

The Dhaka series by Zia-Ur-Rahman, et al., reported satisfactory outcomes in 67% of patients, with complications including haemorrhage (15%), neck pain (12%), superficial infection (10%) and screw pullout (10%) [19]. Our complication rates are lower (superficial infection 6.3%, screw pullout 2.1%), possibly reflecting differences in patient population, surgical technique or perioperative care.

Direct comparison with previous Nigerian studies is limited by the scarcity of published data on cervical spine surgery. Idowu et al. reported on 26 patients undergoing posterior spinal stabilization for various indications, including trauma, with 96% of patients showing improvement and no neural or vascular injuries [13]. However, their series included predominantly lumbar cases (46.2%), with limited cervical data. The present study provides specific outcome data for cervical lateral mass screw fixation in a Nigerian cohort.

The overall complication rate of 16.7% in this series is acceptable and comparable to the 13-20% range reported internationally [10-12,21]. Superficial wound infection (6.3%) is a concern in our setting, where patients often present with delayed referral and suboptimal nutritional status. This rate is higher than the 4% reported by Ali, et al., but lower than the 10% reported in the Dhaka series [11,19]. Transient C5 radiculopathy (4.2%) is a well-recognised complication following posterior cervical surgery, attributed to tethering of the C5 nerve root following posterior shift of the spinal cord after decompression [25]. All cases in our series resolved with conservative management within 3-6 months.

Screw malposition requiring revision occurred in one patient (2.1%), comparable to the 2% reported by Ali, et al., and lower than the 10% screw pullout rate reported in the Dhaka series [11,19]. The use of fluoroscopic guidance and adherence to established anatomical landmarks (Magerl or Anderson techniques) minimises this risk [6,18]. Notably, there were no vertebral artery injuries in this series, attesting to the safety of lateral mass screw placement when appropriate trajectories are used [9]. This compares favourably with the 0.2-4% risk reported for cervical pedicle screw fixation [26].

These findings have several implications for spinal surgery practice in Nigeria:

1. Surgical approach selection: Lateral mass screw fixation is a safe and effective technique for traumatic subaxial cervical spine injuries, providing excellent neurological recovery and fusion rates with acceptable complications
2. Early referral: The greater improvement in patients with incomplete deficits supports early surgical referral for patients with cervical trauma and neurological involvement [22]
3. Training implications: NOH, Dala's role as a training centre for orthopaedic residents across northern Nigeria positions it to disseminate best practices in cervical spine trauma management throughout the region [14]
4. Infrastructure development: Continued investment in fluoroscopy and surgical instrumentation is essential to maintain and improve outcomes
5. Trauma prevention: The predominance of road traffic accidents underscores the urgent need for road safety interventions to reduce the burden of cervical spine injuries [3]

This study has several limitations. First, its retrospective design introduces potential selection bias and reliance on accurate medical records. Second, the exclusion of patients with incomplete records (10.3%) and those lost to follow-up (6.9%) may have influenced outcome estimates. Third, the absence of a comparison group (anterior surgery or conservative management) limits conclusions about the relative effectiveness of different treatment approaches. Fourth, the 12-month follow-up, while adequate for assessing fusion and early outcomes, may not capture late implant failure or adjacent segment degeneration. Fifth, functional outcomes beyond neurological status and pain were not systematically assessed using validated instruments such as the Neck Disability Index. Sixth, single-centre design limits generalisability to other Nigerian hospitals with different resources and expertise levels.

Prospective multicentre studies with standardised data collection, longer follow-up (2-5 years) and inclusion of comprehensive patient-reported outcome measures are needed to further define the role of lateral mass screw fixation for cervical trauma in Nigeria. Comparative effectiveness research comparing early versus delayed surgery and posterior versus anterior approaches, would inform treatment algorithms. Establishing a national spine trauma registry would facilitate ongoing quality improvement and benchmarking against international standards. Finally, research into barriers to early presentation and strategies to reduce referral delays is needed to optimise outcomes [27-30].

Conclusion

This retrospective series demonstrates that lateral mass screw fixation for traumatic subaxial cervical spine injuries at the National Orthopaedic Hospital, Dala, Kano, achieves significant neurological improvement (72.7% of patients with deficits), high fusion rates (91.7%) and acceptable complication rates (16.7%), comparable to international published series. The predominance of road traffic accidents as the mechanism of injury highlights the need for continued road safety interventions. These findings support the continued use of lateral mass screw fixation as a safe and effective stabilisation technique for traumatic cervical spine injuries in Nigerian tertiary centres and provide baseline data for future research and quality improvement initiatives.

Conflict of Interest

The authors declared no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

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Data Availability Statement

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

Ethical Statement

The project did not meet the definition of human subject research under the preview of the IRB according to federal regulations and therefore was exempt.

Informed Consent Statement

Informed consent was obtained from all participants included in the study.

Authors' Contributions

All authors contributed equally to this paper.

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