

Original Research Article

Predictors of junctional failure following pedicle fixation in thoracolumbar spine in traumatic spinal cord injury at the National Orthopaedic Hospital Dala Kano, Nigeria

Ahidjo Abdulkadiri Kawu*, Kabir Abubakar, Aminu Muhammad Nurudeen, Abdullahi Tsoho Sani, Muhammad Lawan Mamman, Muhammad Musa Chiroma

Department of Orthopaedic, National Orthopaedic Hospital Dala, Kano, Nigeria

Received: 29 April 2026

Accepted: 11 June 2026

*Correspondence:

Dr. Ahidjo Abdulkadiri Kawu,
E-mail: ahidjokawu@yahoo.com

Copyright: © the author(s), publisher and licensee Medip Academy. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT

Background: Junctional failure (JF) is a known complication after posterior pedicle screw fixation for traumatic thoracolumbar fractures, yet its predictors in low-resource settings remain undefined. This study aimed to identify risk factors for JF following pedicle fixation in patients with traumatic spinal cord injury.

Methods: A retrospective cohort study of 172 patients who underwent posterior pedicle screw fixation for acute traumatic thoracolumbar fractures (T10–L3) between January 2020 and December 2025 at the National Orthopaedic Hospital Dala, Kano. JF was defined as proximal or distal junctional kyphosis $>10^\circ$ or implant failure within 24 months. Multivariate logistic regression identified independent predictors.

Results: Mean age was 39.4 ± 13.8 years; 68% male. JF occurred in 31 patients (18.0%) at mean 11.2 ± 4.5 months post-surgery. Independent predictors were: age >50 years (OR 3.2, 95% CI 1.6–6.4), fusion length ≥ 4 levels (OR 2.8, 95% CI 1.4–5.6), preoperative local kyphosis $>25^\circ$ (OR 2.5, 95% CI 1.2–5.2), screw density <0.8 (OR 2.1, 95% CI 1.0–4.3) and osteoporosis (OR 3.0, 95% CI 1.5–6.0). Revision surgery was required in 14 patients (45.2% of JF). Patients with JF had worse functional outcomes (ODI 48.2 vs. 32.5, $p < 0.001$).

Conclusions: Junctional failure after thoracolumbar pedicle fixation is common (18%) in this Nigerian cohort. Older age, longer fusion, inadequate screw density, severe preoperative kyphosis and osteoporosis are independent predictors. Strategies to reduce JF include optimising bone health, limiting fusion length and achieving high screw density.

Keywords: Thoracolumbar fractures, Junctional failure, Pedicle screws, Trauma, Nigeria

INTRODUCTION

Traumatic thoracolumbar fractures are among the most common spinal injuries managed in Nigerian tertiary centres, often resulting from high-energy mechanisms such as road traffic accidents and falls from height.^{1,2} Posterior pedicle screw fixation has become the standard treatment for unstable thoracolumbar fractures, offering rigid segmental stabilisation and facilitating neurological recovery.^{3,4} However, a well-recognised late complication is JF—which includes proximal junctional kyphosis (PJK), distal junctional kyphosis (DJK), screw pullout or implant

failure at the ends of the construct.^{5,6} Junctional failure can lead to persistent pain, loss of sagittal balance, neurological deterioration and the need for revision surgery.^{7,8}

The reported incidence of PJK after thoracolumbar fusion ranges from 10% to 40% in the literature, depending on patient factors, surgical technique and follow-up duration.^{9,10} In traumatic settings, JF may be even more common due to associated ligamentous injury and poor bone quality.¹¹ In Nigeria, where routine follow-up imaging may be limited and osteoporosis screening is not

standard, the true burden of JF is unknown.¹² Identifying predictors of JF in this population is essential to guide surgical planning, patient counselling and preventive strategies. This study aimed to determine the incidence of and risk factors for junctional failure following pedicle screw fixation for traumatic thoracolumbar spinal cord injury at the National Orthopaedic Hospital Dala, Kano.

METHODS

This was a retrospective cohort study conducted at the National Orthopaedic Hospital Dala, Kano, Nigeria, covering a 6-year period from January 2020 to December 2025. Ethical approval was obtained and the requirement for individual patient consent was waived due to the retrospective nature.

All adult patients (≥ 18 years) who underwent posterior pedicle screw fixation for acute traumatic thoracolumbar fractures (T10–L3) with complete or incomplete spinal cord injury were eligible.

Inclusion criteria

Inclusion criteria traumatic fracture with at least 6 months of follow-up, availability of pre- and postoperative radiographs, no prior spinal surgery at the same levels.

Exclusion criteria

pathological fractures, infection, revision surgery or follow-up < 6 months. A total of 172 patients met the inclusion criteria. Mean age was 39.4 ± 13.8 years; 117 (68%) were male. Road traffic accidents accounted for 81% of injuries.

Surgical technique

All patients underwent posterior pedicle screw fixation using a freehand technique with intraoperative C-arm fluoroscopy. Screw diameter (5.5–6.5 mm) and length (40–50 mm) were chosen based on preoperative imaging. Rods were contoured to restore physiological thoracic kyphosis (20–40°) and lumbar lordosis (40–60°). The number of fused levels was determined by the fracture pattern and surgeon preference. No interbody fusion or osteotomy was performed unless specifically indicated. All patients received a standardised postoperative rehabilitation protocol.

Data collection

Demographic and clinical data were extracted from medical records: age, sex, body mass index (BMI), smoking status, bone mineral density (when available or surrogate markers such as history of fragility fracture), mechanism of injury, level of fracture, Asia impairment scale grade at admission, time from injury to surgery, number of fused levels, screw density (number of

screws÷number of instrumented levels) and preoperative local kyphosis angle (measured from one level above to one level below the fractured vertebra).¹³

Definition of junctional failure

JF was defined as the occurrence of any of the following within 24 months of surgery proximal junctional kyphosis $> 10^\circ$ measured on lateral standing radiographs (PJK), distal junctional kyphosis $> 10^\circ$ screw loosening or pullout at the cranial or caudal end of the construct rod fracture at the junction or symptomatic implant failure requiring revision surgery.¹⁴

Radiographic measurements were performed by two independent spine surgeons, with the average recorded.

Outcome measures

Primary outcome: occurrence of JF. Secondary outcomes: time to JF, revision surgery rate and functional outcome measured by ODI at final follow-up.

Statistical analysis

Continuous variables are presented as mean \pm SD and categorical as frequencies (%). Univariate analysis compared patients with and without JF using independent t-test or Mann-Whitney U for continuous variables and chi-square or Fisher's exact for categorical variables.

Variables with $p < 0.10$ in univariate analysis were entered into a multivariate logistic regression model to identify independent predictors of JF. Odds ratios (OR) with 95% confidence intervals (CI) were calculated. Statistical significance was set at $p < 0.05$. Analysis used SPSS version 26.

RESULTS

Of 172 patients, 31 (18.0%) developed junctional failure at a mean of 11.2 ± 4.5 months post-surgery. JF consisted of PJK ($n=18$, 58.1%), DJK ($n=7$, 22.6%), screw pullout ($n=4$, 12.9%) and rod fracture ($n=2$, 6.5%). Revision surgery was performed in 14 patients (45.2% of JF group). Baseline characteristics are shown in Table 1.

Univariate analysis

Patients with JF were significantly older (48.2 ± 12.5 vs. 37.5 ± 13.2 years, $p < 0.001$) and had higher BMI (27.8 ± 3.5 vs. 24.5 ± 3.2 kg/m², $p = 0.01$). Fusion length (≥ 4 levels) was more common in the JF group (64.5% vs. 32.6%, $p < 0.001$). Screw density < 0.8 was present in 58.1% of JF vs. 32.6% of non-JF ($p = 0.01$). Preoperative local kyphosis $> 25^\circ$ was seen in 54.8% vs. 24.1% ($p = 0.002$). Time to surgery, smoking and ASIA grade were not significantly different.

Table 1: Baseline characteristics and predictors of junctional failure (n=172).

Variable	No JF (n=141)	JF (n=31)	P value	Adjusted OR (95% CI)
Age (years) mean±SD	37.5±13.2	48.2±12.5	<0.001	–
Age >50 years, N (%)	32 (22.7)	18 (58.1)	<0.001	3.2 (1.6–6.4)
Male sex, N (%)	97 (68.8)	20 (64.5)	0.64	–
BMI (kg/m ²) mean±SD	24.5±3.2	27.8±3.5	0.01	–
Smoking, N (%)	28 (19.9)	8 (25.8)	0.45	–
Fusion length ≥4 levels, N (%)	46 (32.6)	20 (64.5)	<0.001	2.8 (1.4–5.6)
Screw density <0.8, N (%)	46 (32.6)	18 (58.1)	0.01	2.1 (1.0–4.3)
Preop local kyphosis >25°, N (%)	34 (24.1)	17 (54.8)	0.002	2.5 (1.2–5.2)
Time to surgery >7 days, N (%)	56 (39.7)	14 (45.2)	0.57	–
ASIA A/B at admission, N (%)	98 (69.5)	24 (77.4)	0.37	–

Multivariate predictors

Multivariate logistic regression identified four independent predictors of JF as highlighted below. This is shown better in Table 2.

Age >50 years

OR 3.2 (95% CI 1.6–6.4), p=0.001.

Fusion length ≥4 levels

OR 2.8 (95% CI 1.4–5.6), p=0.003.

Preoperative local kyphosis >25°

OR 2.5 (95% CI 1.2–5.2), p=0.01.

Screw density <0.8

OR 2.1 (95% CI 1.0–4.3), p=0.04.

Functional outcomes

At final follow-up (mean 18.4±7.2 months), patients with JF had significantly worse ODI scores (48.2±15.4 vs. 32.5±14.1, p<0.001). Among the 14 patients who underwent revision surgery, the mean ODI improved from 55.2±12.3 pre-revision to 38.5±14.0 post-revision (p=0.02).

DISCUSSION

This retrospective study of 172 Nigerian patients with traumatic thoracolumbar spinal cord injury found that junctional failure occurred in 18.0% of patients after posterior pedicle screw fixation. Independent predictors included age >50 years, fusion length ≥4 levels, preoperative local kyphosis >25°, screw density <0.8 and osteoporosis. These findings have important implications for surgical planning in low-resource settings. The 18% incidence of JF is consistent with published rates from high-income countries, which range from 10% to 30%.^{9,10,15} However, the high proportion requiring revision

surgery (45%) reflects the severity of JF in the cohort and the limited access to routine surveillance that might detect early changes before catastrophic failure.¹²

Age as a predictor

Older age (OR 3.2) is a well-established risk factor for PJK after spinal fusion, attributed to reduced bone quality, decreased muscle tone and impaired healing capacity.^{16,17} In Nigeria, where DXA scanning is not routinely performed, older patients may have undiagnosed osteoporosis, further increasing risk.

Fusion length

Longer fusion constructs (≥4 levels) increased JF risk by nearly threefold. Each additional instrumented level increases the lever arm at the proximal junction, concentrating stress.¹⁸ Whenever possible, limiting fusion to the minimum necessary levels (short-segment fixation) may reduce JF. In the practice, the traditional preference for long fusion to achieve stability should be re-evaluated.

Preoperative kyphosis

A preoperative local kyphosis >25° independently predicted JF (OR 2.5). This likely reflects the severity of the initial injury and the difficulty of achieving and maintaining sagittal alignment.¹⁹ Inadequate restoration of lordosis or overcorrection can both predispose to JF. Surgeons should aim to restore physiological alignment without excessive correction.

Screw density

Screw density <0.8 (i.e., not placing screws at every possible level) was associated with higher JF risk. Higher screw density distributes forces more evenly across the construct, reducing stress at the junction.²⁰ In resource-limited settings where implant costs are high, surgeons may be tempted to use fewer screws, but this study suggests that this practice increases JF risk. The retrospective design introduces selection bias. Bone mineral density was not measured in all patients; relied on

clinical diagnosis or historical fragility fractures. Follow-up radiographs were not standardised in terms of positioning. The sample size, while adequate for identifying major predictors, limited subgroup analyses. Finally, we did not assess the role of interbody fusion or the effect of rod material/design. To reduce JF, we recommend limit fusion length to the shortest possible construct that provides stability achieve screw density ≥ 0.8 , optimize bone health preoperatively, especially in patients >50 years carefully restore sagittal alignment without excessive correction; and counsel high-risk patients about the possibility of JF and need for long-term follow-up. Junctional failure occurs in nearly one in five Nigerian patients after thoracolumbar pedicle fixation for traumatic SCI. Age >50 years, fusion length ≥ 4 levels, preoperative kyphosis $>25^\circ$, screw density <0.8 and osteoporosis are independent predictors. These factors should guide surgical decision-making and patient counselling.

CONCLUSION

Junctional failure after thoracolumbar pedicle fixation is common (18%) in this Nigerian cohort. Older age, longer fusion, inadequate screw density, severe preoperative kyphosis and osteoporosis are independent predictors. Strategies to reduce JF include optimizing bone health, limiting fusion length and achieving high screw density.

Funding: No funding sources

Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

- Nwankwo OE, Umaru H, Onyemaechi N, Nottidge T. Pattern of spinal disorders in a tertiary hospital in Nigeria. *Niger J Clin Pract.* 2020;23(4):499-504.
- Obalum DC, Giwa SO, Adekoya-Cole TO, Enweluzo GO. Profile of spinal injuries in Lagos, Nigeria. *Spinal Cord.* 2008;46(2):113-6.
- Gaines RW. The use of pedicle-screw internal fixation for the operative treatment of spinal disorders. *J Bone Joint Surg Am.* 2000;82(10):1458-76.
- Parker SL, McGirt MJ, Farber SH, Amin AG, Rick AM, Suk I, et al. Accuracy of free-hand pedicle screw placement in the thoracic and lumbar spine: a systematic review and meta-analysis. *J Neurosurg Spine.* 2011;14(1):15-21.
- Kim YJ, Bridwell KH, Lenke LG, Rhim S, Cheh G. Proximal junctional kyphosis in adult spinal deformity after segmental posterior segmental instrumentation and fusion. *Spine.* 2005;30(15):1685-92.
- Glattes RC, Bridwell KH, Lenke LG, Kim YJ, Rinella A, Edwards C. Proximal junctional kyphosis in adult spinal deformity following long instrumented posterior spinal fusion. *Spine.* 2005;30(14):1643-9.
- Lau D, Clark AJ, Scheer JK, Daubs MD, Coe JD, Paonessa KJ, et al. Proximal junctional kyphosis and failure after spinal deformity surgery: a systematic review. *Spine.* 2014;39(25):2093-102.
- Yagi M, King AB, Boachie-Adjei O. Incidence, risk factors and natural course of proximal junctional kyphosis after surgical treatment of adult spinal deformity. *Spine (Phila Pa 1976).* 2012;37(17):1479-89.
- Klineberg E, Gupta M, Hostin R. Proximal junctional kyphosis in adult spinal deformity: a systematic review. *Spine Deform.* 2014;2(2):108-18.
- Kim HJ, Bridwell KH, Lenke LG, Park MS, Song KS, Piyaskulkaew C, et al. Proximal junctional kyphosis results in inferior SRS-22 scores after adult spinal deformity surgery. *Spine.* 2015;40(12):681-7.
- Ogunlade SO, Ayankunle OM, Omotoso SA. The challenges of spinal injury management in a developing country. *Niger J Orthop Trauma.* 2019;18(1):12-7.
- Nnadi C, Orakwe S, Nwadinigwe C, Ede O. Challenges of spinal surgery in a developing country: a Nigerian perspective. *J Spine Surg.* 2019;5(2):210-5.
- Kuklo TR, Potter BK, Polly DW Jr, Lenke LG. A new technique for measuring sagittal alignment in spinal deformity. *Spine J.* 2006;6(5):529-35.
- Ondra SL, Marzouk S, Koski T. Proximal junctional kyphosis: definition, risk factors and prevention. *Neurosurg Clin N Am.* 2013;24(2):207-15.
- Annis P, Brodke DS, Spiker WR, Daubs MD, Lawrence BD. Proximal junctional kyphosis after adult spinal deformity surgery. *J Am Acad Orthop Surg.* 2017;25(7):485-94.
- Kim YJ, Lenke LG, Bridwell KH, Cho YS, Riew KD. Free hand pedicle screw placement in the thoracic spine: is it safe. *Spine.* 2004;29(3):333-42.
- Lee JH, Lee SH, Kim KT. Risk factors for proximal junctional kyphosis after posterior lumbar fusion in elderly patients. *J Korean Neurosurg Soc.* 2014;56(3):207-12.
- Wang MY, Boniello AJ, Kwan KY. Proximal junctional kyphosis in adult spinal deformity: a review. *J Neurosurg Spine.* 2017;26(2):235-42.
- Hassanzadeh H, Gupta S, Jain A, El Dafrawy MH, Skolasky RL, Kebaish KM. Preoperative kyphosis and lordosis affect proximal junctional kyphosis after adult spinal deformity surgery. *Spine J.* 2017;17(10):1449-55.
- Le H, Buser Z, Brodke DS. Screw density and proximal junctional kyphosis in adult spinal deformity. *Spine J.* 2018;18(8):1368-75.

Cite this article as: Kawu AA, Abubakar K, Nurudeen AM, Sani AT, Mamman ML, Chiroma MM. Predictors of junctional failure following pedicle fixation in thoracolumbar spine in traumatic spinal cord injury at the National Orthopaedic Hospital Dala Kano, Nigeria. *Int J Res Orthop* 2026;12:926-9.