Pedicle Screws Fixation in Patients with Spinal Disorders at the National Orthopaedic Hospital Dala, Kano, Nigeria

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ABSTRACT

Background: Pedicle screw fixation is the gold standard for spinal stabilization, but outcome data from West African tertiary centres are scarce. This study evaluated the clinical and radiological outcomes of freehand pedicle screw fixation with post-insertion C-arm fluoroscopy at a major Nigerian orthopaedic hospital.

Methods: A retrospective review was conducted of consecutive patients who underwent thoracic or lumbar pedicle screw fixation between 1st January 2018 and 31st December 2024 at National Orthopaedic Hospital Dala, Kano, Nigeria. All screws were inserted freehand and confirmed with intraoperative C-arm imaging. Screw accuracy was graded on postoperative CT using Gertzbein-Robbins classification. Clinical outcomes included VAS back pain, Oswestry Disability Index (ODI), complications, and fusion rates. Multivariate analysis identified predictors of poor functional outcome.

Results: One hundred forty-two patients had 754 screws (592 lumbar, 162 thoracic). Indications: trauma (62.0%), degenerative (18.3%), scoliosis (2.1%), others (17.6%). Overall screw accuracy (grades A/B) was 88.1%. Grade C–E breaches occurred in 11.9%, mostly lateral thoracic. The complication rate was 11.3% (dural tears 3.5%, superficial infection 2.8%, screw revision 2.1%, transient neurology 1.4%). No permanent deficits occurred. At mean 20.5 months, VAS improved from 7.5 to 3.3 ($p<0.001$) and ODI from 55.4 to 27.6 ($p<0.001$). Fusion rate was 90.8%. Screw malposition (OR 2.95) and preoperative psychological distress (OR 2.68) independently predicted poor outcome.

Conclusions: Freehand pedicle screw fixation with C-arm confirmation is safe and effective in this Nigerian tertiary centre, achieving outcomes comparable to international benchmarks. Accuracy and psychological status are key determinants of success.

Keyword: Pedicle screws, C-Arm, Gertzbein-Robbins classification, National Orthopaedic Hospital, Outcome

INTRODUCTION

Spinal disorders constitute a substantial and growing burden in sub-Saharan Africa, where traumatic injuries, degenerative conditions, and infections are prevalent.[1-2] Surgical management often requires instrumented fusion to restore stability and relieve pain. Pedicle screw fixation has become the standard for posterior spinal stabilization, offering three-column purchase, immediate rigidity, and high fusion rates.[3-4] The technique, however, demands precise screw placement to avoid neurological, vascular, and visceral complications.[5-6]

In resource-limited settings, advanced navigation systems and robotic assistance are rarely available. Most spine surgeons rely on the freehand technique, using anatomical landmarks and intraoperative fluoroscopy (C-arm) to confirm screw position after insertion.[7] When performed by experienced surgeons, freehand placement can achieve accuracy rates of 85–94%.[8-9] Nevertheless, local outcome data are essential for benchmarking and quality improvement.

The National Orthopaedic Hospital Dala, Kano, is a tertiary referral centre in northern Nigeria managing a high volume of spinal pathology. Despite increasing surgical caseload, there are few published reports on pedicle screw outcomes in this region.[10] This study aims to evaluate the clinical and radiological outcomes of freehand

pedicle screw fixation in the thoracic and lumbar spine at our institution, with emphasis on screw accuracy, complications, fusion, and factors influencing functional recovery.

METHODOLOGY

A retrospective cohort study was conducted at National Orthopaedic Hospital Dala, Kano, Nigeria, covering January 2017 to December 2023. Ethical approval was obtained and informed consent was waived due to the retrospective nature. All patients aged ≥18 years who underwent pedicle screw fixation involving the thoracic and/or lumbar spine were eligible. All the screws were from China, India and Pakistan. Inclusion criteria: freehand screw placement with post-insertion C-arm confirmation; available postoperative computed tomography (CT); complete clinical records with ≥12 months follow-up. Exclusion: cervical instrumentation; use of navigation/robotics; incomplete records.

All surgeries were performed by fellowship-trained orthopaedic spine surgeons. Patients were positioned prone on a radiolucent table. A standard midline posterior approach was used. Pedicle entry points were identified using anatomical landmarks: for lumbar spine, the intersection of transverse process and superior articular facet; for thoracic spine, the junction of transverse process and pars interarticularis.[11] A high-speed burr created the starting point, followed by sequential probing with a hand-held pedicle finder. After palpation of bony walls, tapping and screw insertion were performed. Following placement of all screws, intraoperative C-arm fluoroscopy (anteroposterior and lateral) was used to confirm position. Screws deemed mal-positioned were revised immediately. No intraoperative navigation or CT was used.

Demographic, clinical, and operative data were extracted from medical records: age, sex, body mass index (BMI), smoking, comorbidities, ASA class, diagnosis, number and levels of screws, operative time, estimated blood loss, hospital stay, and complications.

Postoperative CT within 72 hours was evaluated by two spine surgeons blinded to outcomes using the Gertzbein-Robbins classification[12]: grade A (no breach), B (<2 mm), C (2–4 mm), D (4–6 mm), E (>6 mm). Accuracy was defined as grades A or B. Fusion was assessed at 12 months using dynamic radiographs and CT, defined as continuous bridging trabecular bone and <3° motion.[13]

Primary outcomes: screw accuracy, 90-day complications, 12-month fusion. Secondary outcomes: back pain (VAS 0–10) and functional disability (Oswestry Disability Index, ODI 0–100) preoperatively and at final follow-up. MCID for ODI was ≥15-point reduction.[14] Preoperative psychological distress was assessed using the Hospital Anxiety and Depression Scale (HADS, score ≥11).[15]

Continuous variables are mean ±SD; categorical as frequencies. Comparisons used t-test, Mann-Whitney U, or chi-square. Multivariate logistic regression identified predictors of poor functional outcome (failure to achieve ODI MCID or final ODI >40). Significance $p<0.05$. SPSS v26 (IBM Corp.).

RESULTS

One hundred forty-two patients were included. Mean age was 52.6±13.5 years; 78 (54.9%) were female. Baseline characteristics are in Table 1. Trauma was the most common indication (62.0%), followed by degenerative diseases (18.3%). Only three patients (2.1%) had scoliosis surgery. A total of 754 screws were placed: 592 (78.5%) lumbar, 162 (21.5%) thoracic. Mean screws per patient 5.3±1.6. Mean operative time 210±62 min, blood loss 325±160 mL, hospital stay 7.2±4.5 days.

Overall accuracy (grades A/B) was 88.1% (664/754). Grade A (no breach) 74.9%, B 13.2%. Grade C–E breaches occurred in 11.9% (90 screws). Among these, 61 (67.8%) were thoracic, 29 (32.2%) lumbar. Lateral breaches predominated (57.8%). Sixteen screws (2.1%) required revision for malposition; all were revised during the same admission. Table 2 details accuracy. Figures 1 to 5 shows Xray and CT images of pedicle screws fixations.

Sixteen patients (11.3%) experienced complications (Table 3). Dural tears occurred in 5 (3.5%), all repaired primarily. Superficial surgical site infections in 4 (2.8%), managed conservatively. Screw malposition requiring

reoperation in 3 (2.1%). Transient neurological deficits in 2 (1.4%), resolving within 6 weeks. No permanent deficits, vascular injuries, or deep infections occurred.

At mean follow-up 20.5±6.2 months, significant improvements were seen (Table 4). VAS back pain decreased from 7.5±1.6 to 3.3±1.8 ($p<0.001$). ODI decreased from 55.4±14.9 to 27.6±13.2 ($p<0.001$). MCID for ODI was achieved by 117 patients (82.4%). Fusion at 12 months was 90.8% (129 patients).

Univariate analysis identified screw malposition (grade C–E), preoperative psychological distress (HADS ≥11), multilevel fusion (≥3 levels), and age ≥70 years as associated with poor outcome ($p<0.05$). In multivariate regression, screw malposition (OR 2.95, 95% CI 1.61–5.42, $p<0.001$) and preoperative psychological distress (OR 2.68, 95% CI 1.47–4.89, $p<0.001$) remained independent predictors.

DISCUSSION

This study represents one of the largest series of pedicle screw fixation reported from a West African tertiary centre. Our results demonstrate that freehand screw placement with post-insertion C-arm fluoroscopy yields acceptable accuracy (88.1%), fusion (90.8%), and complication rates (11.3%) in a resource-limited setting, comparable to published data from high-income countries [8, 9, 16].[8-9,16]

The accuracy rate aligns with previous freehand studies. Kim et al.[11] reported 94% accuracy for thoracic screws, and Belmont et al.[17] 87%. The higher proportion of thoracic breaches (67.8%) reflects anatomical challenges: smaller pedicle size, greater variability, and proximity to vital structures.[18] Most breaches were lateral and of minor degree, rarely requiring revision. The 2.1% revision rate is similar to that reported[19] with navigation, suggesting that freehand technique, when performed by experienced surgeons, remains a safe alternative in settings where navigation is unavailable.

Complications were within expected ranges. Dural tears (3.5%) are consistent with rates of 3–5% in posterior spinal surgery [20]. Superficial infection (2.8%) is acceptable, though ongoing infection control is critical. Notably, no permanent neurological deficits occurred, affirming the safety of meticulous freehand technique combined with intraoperative fluoroscopic verification.[21]

Clinical improvements were substantial, with over 80% achieving ODI MCID. These outcomes mirror those from international registries.[22] The independent association of screw malposition with poorer functional recovery reinforces the importance of accuracy; even minor breaches can lead to delayed return to function and reduced fusion.[3,23] This supports the use of adjunctive technologies such as intraoperative CT or navigation in complex cases when resources permit.

Preoperative psychological distress emerged as a strong predictor of poor outcome, consistent with growing evidence linking anxiety and depression to suboptimal results after spine surgery.[15,24] In Nigeria, mental health services are limited, and preoperative psychological screening is not routine. Our findings suggest that identifying at-risk patients and providing targeted support- even simple counselling- could improve overall outcomes.

The low number of scoliosis cases (n=3) reflects the predominance of traumatic and degenerative conditions in our practice. Deformity surgery is more resource-intensive and often delayed due to cost and implant availability; nevertheless, our results in these few cases were acceptable.

This study is retrospective, with inherent selection and information biases. Single-centre design may limit generalizability. Follow-up (mean 20.5 months) may not capture late complications like adjacent segment disease. The lack of a control group (e.g., navigated insertion) precludes direct comparison. Additionally, psychological assessment was based on HADS rather than formal psychiatric evaluation, and access to mental health support was not standardized.

Freehand pedicle screw fixation with post-insertion C-arm fluoroscopy is a safe and effective technique for thoracic and lumbar spinal stabilization at National Orthopaedic Hospital Dala, Kano, Nigeria. Outcomes, including accuracy, fusion, and complication rates, are comparable to international benchmarks. Screw

malposition and preoperative psychological distress independently predict poorer functional recovery. These findings support continued use of the freehand technique in resource-limited settings while highlighting opportunities for quality improvement, including targeted use of navigation in complex anatomy and integration of psychological assessment into preoperative care.

REFERENCES

1. 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.
2. Akinyemi RO, Ige OK, Adeyinka AO, Odebode TO. Pattern of spinal injuries in a Nigerian tertiary hospital. J Neurosci Rural Pract. 2013;4(3):268–72.
3. Orlandi V, Galieri G, Mazzucchi E, Pignotti F, Carcagnì A, Bazzu P, et al. Comparative Analysis of Pedicle Screw Fixation and Interspinous Devices in Lumbar Spinal Fusion: Clinical and Surgical Outcomes in Degenerative Spine Conditions. J Pers Med. 2025;15(3):95.
4. Gaines RW Jr. The use of pedicle-screw internal fixation for the operative treatment of spinal disorders. J Bone Joint Surg Am. 2000;82(10):1458–76.
5. Hicks JM, Singla A, Shen FH, Arlet V. Complications of pedicle screw fixation in scoliosis surgery: a systematic review. Spine (Phila Pa 1976). 2010;35(11):E465–70.
6. Jutte PC, Castelein RM. Complications of pedicle screws in lumbar and lumbosacral fusions in 105 consecutive primary operations. Eur Spine J. 2002;11(6):594–8.
7. Modi HN, Suh SW, Fernandez H, Yang JH, Song HR. Accuracy and safety of pedicle screw placement in neuromuscular scoliosis with free-hand technique. Eur Spine J. 2008;17(12):1686–96.
8. Kim YJ, Lenke LG, Cho YS, Bridwell KH, Sides B, Blanke K. Free hand pedicle screw placement in the thoracic spine: a prospective study of accuracy in 702 screws. Spine (Phila Pa 1976). 2005;30(8):918–22.
9. 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.
10. Nnadi C, Orakwe S, Nwadinigwe C, Ede O. Challenges of spinal surgery in a developing country: a Nigerian perspective. J Spine Surg. 2019;5(Suppl 2):S210–S215.
11. Kim YJ, Lenke LG, Bridwell KH, Cho YS, Riew KD. Free hand pedicle screw placement in the thoracic spine: is it safe? Spine (Phila Pa 1976). 2004;29(3):333–42.
12. Gertzbein SD, Robbins SE. Accuracy of pedicular screw placement in vivo. Spine (Phila Pa 1976). 1990;15(1):11–4.
13. Carreon LY, Glassman SD, Djurasovic M. Reliability and agreement between fine-cut CT scans and plain radiography in the evaluation of posterolateral fusions. Spine J. 2007;7(1):39–43.
14. Copay AG, Glassman SD, Subach BR, Berven S, Schuler TC, Carreon LY. Minimum clinically important difference in lumbar spine surgery patients: a choice of methods using the Oswestry Disability Index, Medical Outcomes Study questionnaire Short Form 36, and pain scales. Spine J. 2008;8(6):968–74.
15. Zigmond AS, Snaith RP. The hospital anxiety and depression scale. Acta Psychiatr Scand. 1983;67(6):361–70.
16. Smith JS, Shaffrey CI, Ames CP, Lenke LG. Treatment of adult thoracolumbar spinal deformity: past, present, and future. J Neurosurg Spine. 2019;30(5):551–67.
17. Belmont PJ Jr, Klemme WR, Dhawan A, Polly DW Jr. In vivo accuracy of thoracic pedicle screws. Spine (Phila Pa 1976). 2001;26(21):2340–6.
18. Zindrick MR, Wiltse LL, Doornik A, Widell EH, Knight GW, Patwardhan AG, et al. Analysis of the morphometric characteristics of the thoracic and lumbar pedicles. Spine (Phila Pa 1976). 1987;12(2):160–6.
19. Hwang YH, Ha BJ, Kim HC, Lee BH, Park JY, Chin DK, et al. A Propensity Score-Matched Cohort Study Comparing 3 Different Spine Pedicle Screw Fixation Methods: Freehand, Fluoroscopy-Guided, and Robot-Assisted Techniques. Neurospine. 2024;21(1):83–94.

20. Guerin P, El Fegoun AB, Obeid I, Gille O, Lelong L, Luc S, et al. Incidental durotomy during spine surgery: incidence, surgical management and outcome. Orthop Traumatol Surg Res. 2012;98(6 Suppl):S129–34.
21. Puvanesarajah V, Hassanzadeh H. The True Cost of a Dural Tear: Medical and Economic Ramifications. Clin Spine Surg. 2017;30(10):445–7.
22. Impact of pedicle screw accuracy on clinical outcomes after 1- or 2-level minimally invasive transforaminal lumbar interbody fusion. J Neurosurg Spine. 2025 Jan 17:1–9.
23. Celestin J, Edwards RR, Jamison RN. Pretreatment psychosocial variables as predictors of outcomes following lumbar surgery and spinal cord stimulation: a systematic review and meta-analysis. Pain Med. 2009;10(4):639–53.

TABLES

Table 1. Baseline Demographic and Surgical Characteristics (n=142)

Characteristic	Value
Demographics	
Age (years) mean ± SD	52.6 ± 13.5
Female sex n (%)	78 (54.9)
BMI (kg/m²) mean ± SD	26.8 ± 4.3
Smoking n (%)	24 (16.9)
ASA class III/IV n (%)	38 (26.8)
Surgical indications n (%)	
Trauma	88 (62.0)
Degenerative disease	26 (18.3)
Scoliosis	3 (2.1)
Tumor	10 (7.0)
Infection	8 (5.6)
Revision	7 (4.9)
Operative data	
Total screws	754
Thoracic screws n (%)	162 (21.5)
Lumbar screws n (%)	592 (78.5)
Screws per patient mean ± SD	5.3 ± 1.6
Operative time (min) mean ± SD	210 ± 62
Blood loss (mL) mean ± SD	325 ± 160
Hospital stay (days) mean ± SD	7.2 ± 4.5

Table 2. Screw Accuracy (Gertzbein-Robbins)

Grade Description	Thoracic (n=162)	Lumbar (n=592)	Total (n=754)
A No breach	116 (71.6%)	449 (75.8%)	565 (74.9%)
B <2 mm breach	24 (14.8%)	75 (12.7%)	99 (13.2%)
A+B (Accurate)	140 (86.4%)	524 (88.5%)	664 (88.1%)
C 2–4 mm breach	15 (9.3%)	41 (6.9%)	56 (7.4%)
D 4–6 mm breach	7 (4.3%)	14 (2.4%)	21 (2.8%)
E 6 mm breach	4 (2.5%)	9 (1.5%)	13 (1.7%)
C–E (Malposition)	26 (16.0%)	64 (10.8%)	90 (11.9%)

Table 3. Perioperative Complications (90 days)

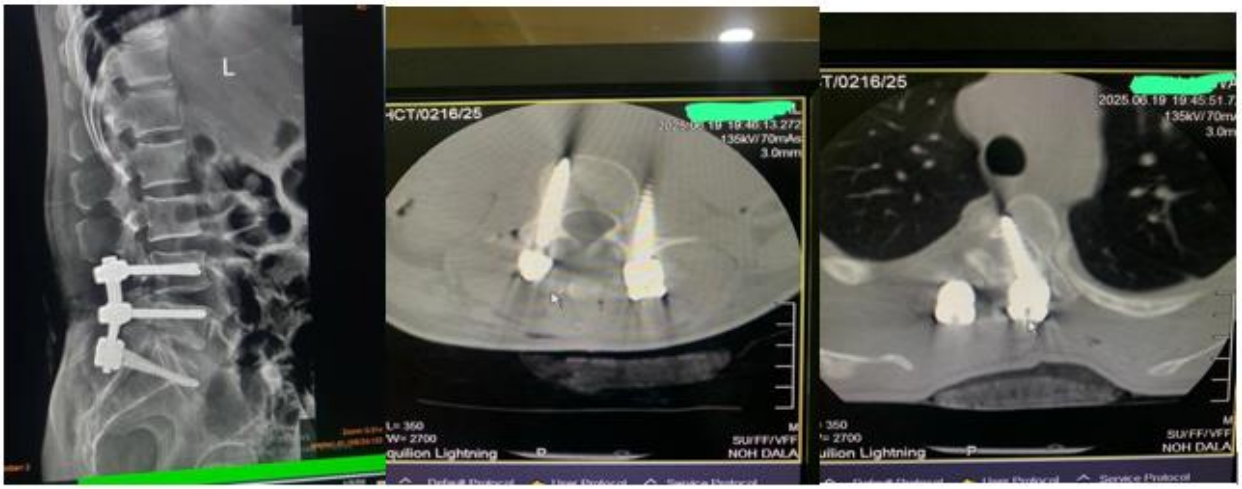
Complication	n % of patients (n=142)
Dural tear	5 (3.5)
Superficial surgical site infection	4 (2.8)
Screw malposition requiring reoperation	3 (2.1)
Transient neurological deficit	2 (1.4)
Deep vein thrombosis	1 (0.7)
Any complication	16 (11.3)
Permanent neurological deficit	0 (0)
Vertebral artery/aortic injury	0 (0)
Deep surgical site infection	0 (0)

Table 4. Clinical Outcomes at Final Follow-up

Outcome	Preoperative	Final follow-up	p value
VAS back pain (0–10)	7.5 ± 1.6	3.3 ± 1.8	<0.001
ODI (0–100)	55.4 ± 14.9	27.6 ± 13.2	<0.001
ODI MCID achieved n (%)	–	117 (82.4)	–
Fusion at 12 months n (%)	–	129 (90.8)	–

Data are mean ± SD. VAS: visual analog scale; ODI: Oswestry Disability Index; MCID: minimal clinically important difference (≥15-point reduction).

Figures 1-5: Showing pedicle screws fixation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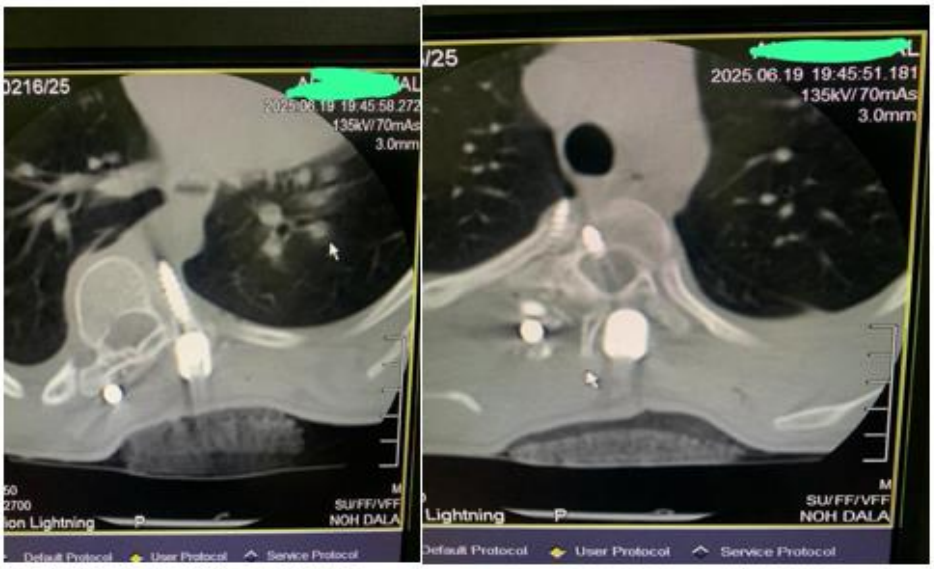
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