International Journal of Research in Orthopaedics
Kawu AA et al. Int J Res Orthop. 2026 Sep;12(5):1252-1256
https://www.ijoro.org

Original Research Article

DOI: https://dx.doi.org/10.18203/issn.2455-4510.IntJResOrthop20262894

How immediate or delayed postoperative x-ray affect reoperation for pedicle screws misplacement following lumbar spine surgery at the National Orthopedic Hospital Dala Kano, Nigeria

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Received: 28 June 2026
Accepted: 05 August 2026

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ABSTRACT

Background: Pedicle screw misplacement is a recognised complication of lumbar spine surgery. The timing of postoperative imaging may influence the detection and subsequent management of misplaced screws. This study aimed to determine whether immediate (within 48 hours) versus delayed (after 48 hours) postoperative x-ray affects the reoperation rate for pedicle screw misplacement following lumbar spine surgery at a Nigerian tertiary hospital.
Methods: A retrospective review of 397 consecutive lumbar spine surgeries performed at the National Orthopedic Hospital Dala, Kano, from January 2019 to December 2025 was conducted. Patients with pedicle screw misplacement detected on postoperative x-ray were identified. Patients were divided into two groups: those who had x-ray within 48 hours of surgery (early group) and those who had x-ray after 48 hours (delayed group). The primary outcome was reoperation for screw misplacement. Multivariate logistic regression was used to identify factors influencing reoperation.
Results: Pedicle screw misplacement was identified in 39 patients (9.8% of all surgeries). In the early x-ray group (n=11), 2 patients (18.2%) required reoperation. In the delayed x-ray group (n=28), 19 patients (67.9%) required reoperation ($p<0.001$). On multivariate analysis, delayed x-ray was the strongest independent predictor of reoperation (adjusted OR = 8.9, 95% CI: 2.4-33.1, $p=0.001$). Other significant predictors included the severity of screw breach (Gertzbein-Robbins grade C-E) (OR=5.6, 95% CI: 1.8-17.4) and the presence of neurological symptoms (OR=4.2, 95% CI: 1.4-12.6).
Conclusions: Delayed postoperative x-ray (>48 hours) is strongly associated with a higher reoperation rate for pedicle screw misplacement. Early detection within 48 hours allows timely intervention and potentially reduces the need for reoperation. Routine early postoperative imaging should be considered to optimize patient outcomes.

Keywords: Lumbar spine surgery, Nigeria, Pedicle screw, Postoperative x-ray, Reoperation, Screw misplacement, Timing of imaging

INTRODUCTION

Pedicle screw fixation is the gold standard for lumbar spine stabilisation, providing three-column fixation and facilitating high fusion rates.[1] However, screw misplacement remains a significant concern, with reported rates ranging from 4.9% to 55% under fluoroscopic guidance.[2,3] Even with navigation assistance, misplacement rates up to 11% have been reported.[4] The consequences of misplacement include neural injury, vascular injury, dural tear, and hardware failure, often necessitating revision surgery.[5,6]

Postoperative imaging is essential for confirming screw position and detecting malposition. Plain radiographs are routinely obtained postoperatively because of their low cost, wide availability, and low radiation exposure.[7] However, the optimal timing of postoperative x-ray- early (within 48 hours) versus delayed (after 48 hours)- has not been extensively studied. A study by Arnaout et al suggested that CT scans should be performed intraoperatively or within 24-48 hours of surgery to confirm screw location and rule out medial or lateral pedicle breaches.[8] Routine postoperative x-rays obtained 48 hours after surgery are standard practice in many institutions, but the clinical impact of earlier detection on reoperation rates is unclear.[8]

The National Orthopedic Hospital Dala, Kano, is a major referral centre for spinal surgery in northern Nigeria. In this resource-limited setting, postoperative imaging protocols vary, with some patients undergoing x-ray within 48 hours and others after a longer delay due to logistical constraints. This variation provides an opportunity to evaluate whether the timing of postoperative imaging influences the likelihood of reoperation for screw misplacement.

This study aimed to: (1) determine the rate of pedicle screw misplacement in a Nigerian cohort; (2) compare reoperation rates between patients who had early (≤48 hours) versus delayed (>48 hours) postoperative x-ray; and (3) identify factors influencing reoperation using multivariate analysis.

METHODS

Study design and setting

This was a retrospective cohort study conducted at the National Orthopedic Hospital Dala, Kano, Nigeria- a 250-bed tertiary orthopedic referral centre. The study period was 1 January 2019 to 31 December 2025. Ethical approval was obtained and individual patient consent was waived due to the retrospective nature.

Participants

All consecutive adult patients (≥18 years) who underwent posterior lumbar spine surgery with pedicle screw instrumentation during the study period were eligible. Inclusion criteria: (1) lumbar spine surgery (L1-S1) with pedicle screw fixation; (2) availability of postoperative x-ray; (3) complete medical records.

Exclusion criteria

Patients who had intraoperative revision of screws or incomplete records. A total of 397 patients met the inclusion criteria.

Identification of screw misplacement

Pedicle screw misplacement was defined as any screw with a breach of the pedicle wall (medial, lateral, superior, or inferior) ≥2 mm, detected on postoperative plain x-ray or CT. The Gertzbein-Robbins classification was used to grade the severity of breach: grade A (no breach), grade B (<2 mm), grade C (2-4 mm), grade D (4-6 mm), and grade E (>6 mm).[9] Screws with grade B or higher were considered misplaced.

Group allocation

Patients with screw misplacement were divided into two groups based on the timing of the postoperative x-ray that first identified the misplacement: early group: x-ray performed within 48 hours of surgery; delayed group: x-ray performed after 48 hours of surgery (range 3-21 days).

Outcome measures

The primary outcome was reoperation for screw misplacement, defined as any surgical intervention (revision, removal, or repositioning of screws) performed due to symptomatic or radiologically significant malposition. Secondary outcomes included the severity of screw breach, presence of neurological symptoms, and time from surgery to reoperation.

Statistical analysis

Data were analysed using SPSS version 26. Categorical variables are presented as frequencies (%), continuous as mean±SD. Comparisons between groups used chi-square or Fisher's exact test for categorical variables and independent t-test for continuous variables. Univariate and multivariate logistic regression were performed to identify independent predictors of reoperation. Variables with $p<0.10$ in univariate analysis were entered into a multivariate model. Adjusted odds ratios (OR) with 95% confidence intervals (CI) were calculated. Statistical significance was set at $p<0.05$.

RESULTS

Patient and screw characteristics

During the study period, 397 lumbar spine surgeries with pedicle screw instrumentation were performed. The mean age was 52.4±14.2 years; 58.4% were male. The most common indications were degenerative disease (54.2%), trauma (28.7%), and infection (17.1%). A total of 39 patients (9.8%) had pedicle screw misplacement identified on postoperative imaging. Of these, 11 patients (28.2%) had early x-ray (≤48 hours), and 28 patients (71.8%) had delayed x-ray (>48 hours). Table 1 presents the baseline characteristics.

Table 1: Baseline characteristics of patients with pedicle screw misplacement (n=39).

Characteristics	Total (n=39)	Early x-ray (n=11)	Delayed x-ray (n=28)	P value
Age (years) mean±SD	52.4±14.2	50.8±15.1	53.0±13.9	0.65
Male sex (%)	23 (59.0)	6 (54.5)	17 (60.7)	0.72
Indication (%)				
Degenerative disease	21 (53.8)	6 (54.5)	15 (53.6)	0.91
Trauma	11 (28.2)	3 (27.3)	8 (28.6)	
Infection	7 (17.9)	2 (18.2)	5 (17.9)	
Level of surgery (%)				
L1-L3	9 (23.1)	3 (27.3)	6 (21.4)	0.70
L4-L5	22 (56.4)	6 (54.5)	16 (57.1)	
L5-S1	8 (20.5)	2 (18.2)	6 (21.4)	
Number of screws mean±SD	3.8±1.2	3.7±1.1	3.9±1.3	0.64

Table 2: Reoperation rates by timing of x-ray.

Group	N	Reoperation (%)	No reoperation (%)	P value
Early x-ray (≤48 hours)	11	2 (18.2)	9 (81.8)	<0.001
Delayed x-ray (>48 hours)	28	19 (67.9)	9 (32.1)	
Total	39	21 (53.8)	18 (46.2)	

Table 3: Univariate analysis of factors associated with reoperation.

Factor	Reoperation (n=21)	No reoperation (n=18)	OR (95% CI)	P value
Delayed X-ray (>48 hours) (%)	19 (90.5)	9 (50.0)	9.5 (1.8-50.1)	0.005
Severe breach (Gertzbein-Robbins C-E) (%)	16 (76.2)	6 (33.3)	6.4 (1.6-25.6)	0.007
Neurological symptoms (%)	13 (61.9)	4 (22.2)	5.7 (1.4-23.2)	0.02
Age >60 years (%)	9 (42.9)	6 (33.3)	1.5 (0.4-5.5)	0.54
Male sex (%)	12 (57.1)	11 (61.1)	0.9 (0.2-3.2)	0.80

Table 4: Multivariate logistic regression- predictors of reoperation.

Predictor	Adjusted OR	95% CI	P value
Delayed x-ray (>48 hours)	8.9	2.4-33.1	0.001
Severe screw breach (grade C-E)	5.6	1.8-17.4	0.003
Neurological symptoms	4.2	1.4-12.6	0.01
Age >60 years	1.4	0.4-4.8	0.59
Male sex	0.9	0.3-2.7	0.85

Hosmer-Lemeshow goodness-of-fit: χ^2=3.8, p=0.87.

Reoperation rates

Overall, 21 of 39 patients (53.8%) with screw misplacement required reoperation. In the early x-ray group, 2 of 11 patients (18.2%) required reoperation, whereas in the delayed x-ray group, 19 of 28 patients (67.9%) required reoperation (p<0.001). Table 2 summarizes the reoperation rates.

Reasons for reoperation

The most common indications for reoperation were: neurological symptoms (radiculopathy or motor weakness) in 12 patients (57.1%), severe medial breach with dural contact in 6 patients (28.6%), and lateral breach with vascular concern in 3 patients (14.3%). The mean time from surgery to reoperation was 5.2±2.8 days in the early group and 14.6±6.4 days in the delayed group (p<0.001).

Predictors of reoperation

Univariate analysis identified delayed x-ray, severe screw breach (Gertzbein-Robbins grade C-E), and the presence of neurological symptoms as factors associated with reoperation (p<0.05). Table 3 presents the univariate analysis.

Multivariate logistic regression (Table 4) identified three independent predictors of reoperation: delayed x-ray (>48 hours): adjusted OR=8.9 (95% CI: 2.4-33.1), p=0.001; severe screw breach (grade C-E): adjusted OR=5.6 (95% CI: 1.8-17.4), p=0.003, neurological symptoms: adjusted OR=4.2 (95% CI: 1.4-12.6), p=0.01.

Age, sex, and indication for surgery were not significant predictors.

DISCUSSION

This study demonstrates that the timing of postoperative x-ray significantly influences the reoperation rate for pedicle screw misplacement. Patients who had delayed x-ray (>48 hours) were nearly nine times more likely to undergo reoperation compared with those who had early x-ray (≤48 hours). This finding has important clinical and resource implications, particularly in resource-limited settings where imaging may be delayed.

Early detection of screw misplacement allows for timely intervention before complications become irreversible. In our cohort, patients in the early group had a mean time to reoperation of 5.2 days, compared with 14.6 days in the delayed group. This delay likely allowed neurological injury to progress or become more severe, necessitating more complex revision surgery. A study by Arnaout et al recommended that CT studies should be performed intraoperatively or within 24-48 hours of surgery to confirm screw location and rule out medial or lateral pedicle breaches.[8] Our findings support this recommendation, extending it to plain radiography.

The 67.9% reoperation rate in the delayed group contrasts sharply with the 18.2% rate in the early group. This suggests that early detection may allow for conservative management or minor intervention (such as screw repositioning) rather than formal reoperation. In some cases, early detection of a lateral breach without symptoms may be managed with observation, whereas a delayed presentation with symptoms almost always requires reoperation.[10]

The multivariate analysis identified delayed x-ray as the strongest predictor of reoperation (OR=8.9). This finding persisted after adjusting for the severity of screw breach and neurological symptoms, indicating that timing of imaging is an independent factor. The severity of screw breach (grade C-E) was also a significant predictor (OR=5.6). Screws with >2 mm breach are more likely to cause neural or vascular injury and are more likely to require revision.[6,10] The presence of neurological symptoms (OR=4.2) is an intuitive predictor; symptomatic patients are more likely to undergo surgery.

The rate of screw misplacement in our cohort (9.8%) is within the range of 4.9-55% reported in the literature.[2,3] The reoperation rate of 53.8% among patients with misplacement is higher than the 0.69% reported in some series, but this reflects the fact that our study included only patients with detected misplacement, whereas most studies report reoperation rates per total screws.[11] A study by Arnaout et al. reported that 4.8% of 145 patients with severe misplacement required reoperation.[8] Our higher rate may reflect delayed presentation and more severe breaches in our cohort.

The finding that delayed imaging increases reoperation risk is consistent with the principle that early detection facilitates less invasive management. In high-income settings, intraoperative CT or O-arm imaging is increasingly used to verify screw placement immediately, reducing the need for postoperative reoperation.[12,13] In resource-limited settings where such technology is unavailable, timely postoperative x-ray is the next best option.

In resource-limited settings like Nigeria, where CT is not always available or affordable, plain x-ray remains the primary modality for postoperative screw assessment. Our findings suggest that performing x-ray within 48 hours of surgery should be a priority. This may require dedicated x-ray slots for postoperative spine patients, clear protocols for imaging requests, and timely reporting. Hospitals should consider implementing a standard protocol that includes early postoperative x-ray for all patients undergoing pedicle screw instrumentation.

This study has several limitations. The retrospective design introduces selection and information bias. The decision to perform early versus delayed x-ray was not randomized; delayed imaging may reflect logistical constraints or a perception that the patient was clinically stable, which could introduce confounding. The sample size of the early group (n=11) was small, limiting statistical power. We did not have access to intraoperative imaging data, which could have identified misplacement earlier. The study did not assess long-term outcomes such as fusion rates or functional recovery. Finally, the single-centre design limits generalizability to other settings.

Prospective studies are needed to confirm the association between imaging timing and reoperation rates. Cost-effectiveness analyses comparing early x-ray versus delayed imaging, and x-ray versus CT, would be valuable in resource-limited settings. The development of a clinical prediction rule to identify patients at high risk of screw misplacement could help target early imaging to those most likely to benefit.

CONCLUSION

In conclusion, delayed postoperative x-ray (>48 hours) is strongly associated with a higher reoperation rate for pedicle screw misplacement. Early detection within 48 hours allows timely intervention and may reduce the need for reoperation. In resource-limited settings, early postoperative x-ray should be considered a routine part of

postoperative care for lumbar spine surgery patients. Hospitals should develop protocols to ensure timely imaging and reporting.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Kawu AA, Misbahu HA, Oderinde GA, Maruf ST, Aremu AB, Buba LB. How immediate or delayed postoperative x-ray affect reoperation for pedicle screws misplacement following lumbar spine surgery at the National Orthopedic Hospital Dala Kano, Nigeria. Int J Res Orthop 2026;12:1252-6.