Journal of Bangladesh College of Physicians and Surgeons
Vol. 43, No. 4, October 2025

Pedicle Subtraction Osteotomy for the Correction of Post-tubercular Kyphotic Deformity in the Thoraco-lumbar Region: A Clinical Outcome Study

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Abstract

Background: *Post-tubercular kyphosis results from vertebral collapse, instability, and canal compromise, leading to progressive pain and neurological risk. Pedicle subtraction osteotomy (PSO) enables single-stage correction through wedge resection of the posterior column and pedicles with an anterior cortical hinge.*

Materials and Methods: *This prospective study was conducted in the Department of Orthopaedic Surgery, BSMMU, Dhaka, from March 2021 to September 2023. Fifteen patients with symptomatic thoraco-lumbar post-tubercular kyphosis underwent single-level PSO. Outcomes were assessed pre-operatively and at 1, 3, 6, and 12 months using the visual analogue scale (VAS), Oswestry disability index (ODI), kyphotic angle, Bridwell fusion criteria, Denis's work scale, and modified Macnab's criteria. Statistical analysis was performed using SPSS v29.0.*

Results: *The study included 10 males and 5 females (mean age 38.6 ± 14.27 years). Farmers (33.3%) and day labourers (26.7%) were most affected. All patients had back pain, weakness, and kyphosis; 53.3% had gait abnormality, 26.7% sensory disturbance, and 6.7% bowel/bladder involvement. L1 was the most common PSO level (66.7%). Complications included one intraoperative dural tear (6.7%), one wound infection (6.7%), and one implant failure (6.7%). Mean hospital stay was 16.7 ± 2.94 days. Mean VAS improved from 7.2 ± 0.41 to 2.4 ± 0.59 ($p < 0.001$). ODI improved from 55.27 ± 5.06 to 14.0 ± 6.70 ($p < 0.001$). Mean kyphotic angle improved from 42.51° ± 3.10 to 5.34° ± 0.85 (correction 37.39° ± 0.83, $p < 0.001$). Radiological fusion (Bridwell grade I) was achieved in 93.3% at 12 months. At one year, 80% had excellent and 20% good outcomes.*

Conclusion: *PSO is a safe and effective procedure for correcting post-tubercular kyphotic deformity, providing significant pain relief, functional improvement, solid fusion, and restoration of sagittal alignment.*

(J Bangladesh Coll Phys Surg 2025; 43: 265-268)
DOI: https://doi.org/10.3329/jbcps.v43i4.85018

Introduction

Kyphotic deformity may result from congenital malformations, infections, trauma, or degenerative conditions. Among these, post-tubercular kyphosis remains a leading cause of spinal deformity in developing countries. It occurs due to vertebral collapse and anterior column destruction, leading to gibbus formation, instability, and neurological deficit. The primary goals of surgery are neural decompression, deformity correction, and stabilization. Pedicle subtraction osteotomy (PSO) allows a single-stage, posterior approach for correction of fixed deformities, typically achieving 30°–40° correction per level. Despite potential risks such as bleeding, infection, and neurological injury, PSO remains an established method for restoring sagittal balance and improving function.

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Received: 26.09.2024 **Accept:** 14.08.2025

Materials and Methods

This prospective interventional study was conducted in the Department of Orthopaedic Surgery, BMU, Dhaka, from March 2021 to September 2023, with purposive sampling of fifteen patients presenting with symptomatic post-tubercular thoraco-lumbar kyphosis.

Inclusion criteria: Patients of both sexes with symptomatic post-tubercular kyphosis, progressive neurological deficit, or radiologically confirmed deformity.

Exclusion criteria: Patients with spinal malignancy, prior instrumented spine surgery, congenital or metabolic deformity, pyogenic infection, or unfit for anaesthesia.

Pre- and post-operative assessments included the visual analogue scale (VAS), Oswestry disability index (ODI), kyphotic angle, Bridwell fusion criteria, Denis's work scale, and modified Macnab's criteria. Radiological evaluation comprised X-ray, MRI, and CT of the dorso-lumbar spine. Data were analysed with SPSS v29.0; $p < 0.05$ was considered significant.

Operative Procedure

Under general anaesthesia, patients were positioned prone. Pedicle screws were placed two levels above and below the deformity. A posterior wedge resection through the vertebral body and pedicles was performed, preserving the anterior cortex as a hinge. Controlled closure achieved correction, followed by posterolateral fusion and instrumentation.

Results

The mean age of patients was 38.6 ± 14.27 years (range 16–62); 66.7% were male. Farmers (33.3%) and day labourers (26.7%) were the main occupational groups. All presented with back pain and kyphosis; 53.3% had gait abnormality, 26.7% sensory disturbance, and 6.7% bowel/bladder involvement. The most common PSO level was L1 (66.7%).

Complications occurred in three patients (20%): one dural tear (6.7%), one wound infection (6.7%), and one implant failure (6.7%). Mean hospital stay was 16.7 ± 2.94 days. There were statistically significant improvements in all outcome measures: VAS from 7.2 ± 0.41 to 2.4 ± 0.59 ($p < 0.001$); ODI from 55.27 ± 5.06 to 14.0 ± 6.70 ($p < 0.001$); kyphotic angle from 42.51° ± 3.10 to 5.34° ± 0.85 (correction 37.39° ± 0.83, $p < 0.001$). Bridwell grade I fusion was achieved in 93.3% of patients at 12 months, and 80% had excellent functional outcomes by Macnab's criteria.

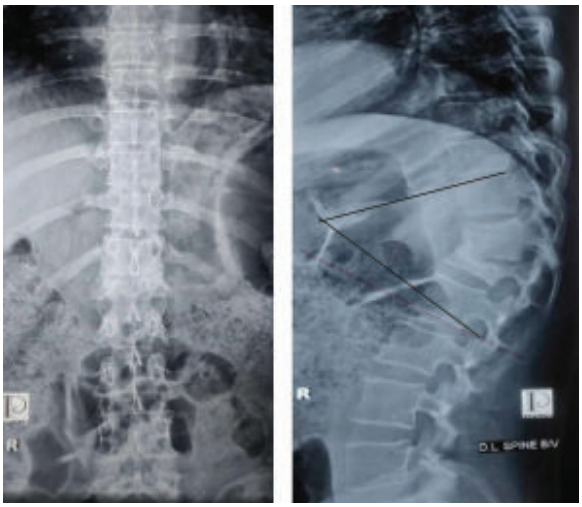

Figure 1: Pre-operative X-ray of Dorso-lumbar spine (Antero-Posterior and lateral view) showing post tubercular kyphotic deformity at dorso lumbar region with kyphotic angle 35^0.

Figure 2: Pre-operative MRI of dorsal to sacral spine T2 sagittal image showing tubercular kyphotic deformity at dorso lumbar region with thecal sac indentation.

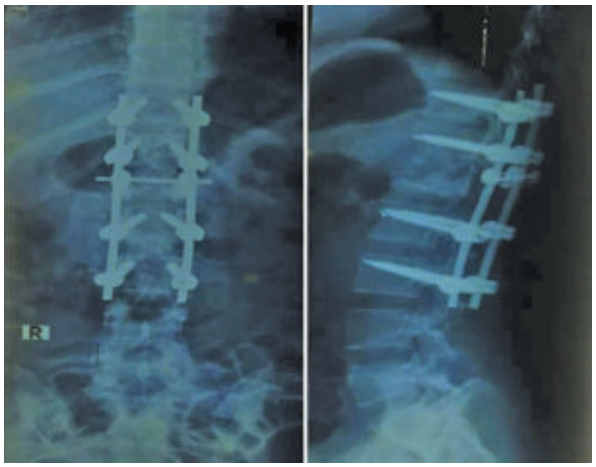

Figure 3: Per-operative picture showing; pedicle screws are inserted above and below the PSO level followed by PSO with diamond bar

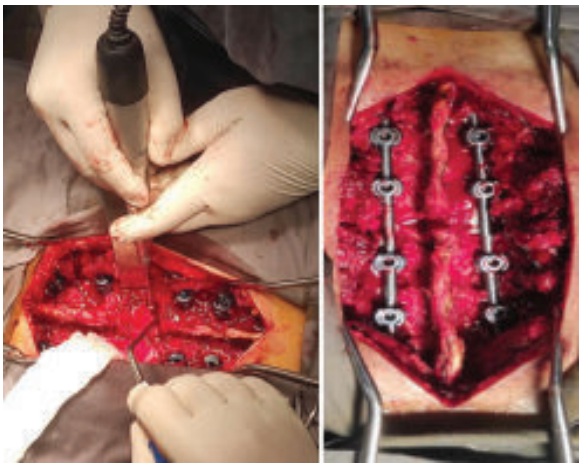

Figure 4: Post-operative (after 1 month of PSO) X-ray Dorso-lumbar spine AP and Lateral view showing proper implant position with correction of kyphosis.

Table - I

Variable	Findings	Measure (Mean ± SD / n, %)	p-value
Age (years)	Range	16–62	—
	Mean	38.6 ± 14.27	—
	Most common age group	25–34 (5 patients, 33.3%)	—
Gender	Male predominant	10 (66.7%)	—
Occupation	Majority farmers and day labourers	Farmers 5 (33.3%), Day labourers 4 (26.7%)	—
Clinical manifestations	Back pain and kyphosis	15 (100%)	—
	Gait abnormality and motor weakness	8 (53.3%)	—
	Sensory disturbance	4 (26.7%)	—
	Bowel/bladder involvement	1 (6.7%)	—
PSO level	Single-level surgery; mostly L1	L1: 10 (66.7%), D12: 4 (26.7%), L2: 1 (6.7%)	—
Peri-/post-operative complications	Total complications	3 (20%)	—
	Dural tear (peri-operative)	1 (6.7%)	—
	Wound infection (post-operative)	1 (6.7%)	—
	Implant failure (post-operative)	1 (6.7%)	—
Hospital stays (days)	Mean duration	16.67 ± 2.94	—
Visual Analogue Scale (VAS)	Pain score reduction pre- to 12 months post-op	7.2 ± 0.41 to 2.4 ± 0.59	<0.001
Bridwell fusion grade I	Radiological fusion at 12 months	14 (93.3%)	Significant increase
Oswestry Disability Index (ODI)	Functional improvement pre- to 12 months post-op	55.27 ± 5.06 to 14 ± 6.70	<0.001
Kyphotic angle (degrees)	Mean correction (pre- to post-op)	42.51 ± 3.10 to 5.34 ± 0.85; correction 37.39 ± 0.83	<0.001
Denis Work Scale	Functional score improvement	4.47 ± 0.49 to 1.27 ± 0.44 pre- to 12 months	<0.001
Modified Macnab's criteria	Excellent outcome at 12 months	12 (80%)	Significant increase

Discussion

The present series demonstrates that single-level PSO provides significant deformity correction and functional recovery in post-tubercular kyphosis. The mean correction achieved (37.39°) aligns with previously published studies by Ashok et al. (2010) and Cho et al. (2005). Functional improvement and fusion rates were comparable with other reports. Complications were minor and manageable. Although intraoperative neuromonitoring was unavailable, no neurological deterioration was observed.

Study limitations include the small sample size, purposive sampling, and relatively short follow-up. Future multicentric studies with larger samples, longer follow-up, and intraoperative neuromonitoring are recommended to validate outcomes and assess long-term spinal alignment and fusion stability.

Conclusion

Pedicle subtraction osteotomy is a safe and effective single-stage procedure for correcting post-tubercular thoraco-lumbar kyphosis. It provides significant pain relief, restoration of sagittal alignment, stable fusion, and improvement in quality of life with minimal complications.

Acknowledgement

The authors gratefully acknowledge the support of the Department of Orthopaedic Surgery, BSMMU, Dhaka, for their assistance throughout the study.

Ethical Clearance

Ethical approval for this study was obtained from the Institutional Review Board (IRB) of BSMMU. Written informed consent was obtained from all participants prior to inclusion in the study.

Conflict of Interest

The authors declare no conflict of interest regarding the publication of this article.

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