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Evaluation of the Outcome of Posterior Decompression and Stabilization by Pedicle Screw and Rods in the Management of Tuberculosis of the Thoracolumbar Spine

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Abstract:

Background: *Thoracolumbar spinal tuberculosis frequently causes neurological deficit, pain and progressive deformity. Surgical intervention is indicated in patients with instability or neurological compromise. This study aimed to evaluate neurological, radiological and functional outcomes following posterior decompression and pedicle screw stabilization in thoracolumbar spinal tuberculosis.*

Methods: *This prospective interventional study was conducted in the Department of Orthopaedic Surgery, Dhaka Medical College Hospital, Bangladesh, from July 2017 to June 2019. A total of 18 consecutive patients diagnosed with thoracolumbar spinal tuberculosis and treated surgically with posterior decompression and pedicle screw stabilization were included. Neurological status was assessed using ASIA grading. Pain was evaluated using the Visual Analogue Scale. Kyphotic angle was measured using Cobb's method. Functional outcome was assessed by modified Macnab criteria. Statistical analysis was performed using paired t-test with significance set at $p<0.05$.*

Results: *The mean age was 39 ± 17.23 years. Postoperatively, 50% achieved ASIA grade E. Mean VAS score improved significantly from 6.94 ± 0.49 to 2.33 ± 0.57 ($p<0.001$). Mean kyphotic angle improved from 28.7 ± 4.5 degrees to 12.5 ± 3.5 degrees. Only one patient (5.56%) developed superficial wound infection. Satisfactory functional outcome was achieved in 94.44% of patients.*

Conclusion: *Posterior decompression and pedicle screw stabilization provide effective neurological recovery, pain relief, deformity correction and favorable functional outcomes with minimal complications in thoracolumbar spinal tuberculosis.*

Keywords: *Thoracolumbar spine, spinal tuberculosis, posterior decompression, pedicle screw fixation.*

1. INTRODUCTION

Spinal tuberculosis is the most frequent form of skeletal tuberculosis and represents a major cause of non-traumatic paraplegia in developing countries [1]. It accounts for nearly half of osteoarticular tuberculosis cases and predominantly involves the thoracic and thoracolumbar regions [2]. The thoracolumbar junction is particularly susceptible because of its transitional biomechanics and relative vascular vulnerability, predisposing it to progressive vertebral collapse and deformity [3]. If not treated appropriately, vertebral destruction may result in kyphotic deformity, instability and neurological compromise [4].

Antitubercular chemotherapy remains the cornerstone of treatment and has significantly reduced disease-related morbidity [5]. However,

medical therapy alone cannot adequately correct mechanical instability or decompress neural elements in patients presenting with significant cord compression [6]. Persistent deformity and late neurological deterioration have been documented even after microbiological cure in conservatively treated cases [7]. Consequently, surgical intervention is indicated in the presence of neurological deficit, progressive deformity, spinal instability, large abscess formation, or failure of medical management [8].

The objectives of surgical management in thoracolumbar spinal tuberculosis include radical debridement, neural decompression, deformity correction and stabilization of the spinal column [6]. Historically, anterior approaches were widely advocated because the disease primarily affects the vertebral bodies [9]. Nevertheless, posterior approaches have gained increasing popularity due to advances in pedicle screw technology and improved understanding of spinal biomechanics [10]. Posterior decompression combined with pedicle screw and rod instrumentation, enables three-column stabilization through a single approach and allows for effective deformity correction [11].

Posterior pedicle screw fixation provides reliable three-column stabilization and decompression, which is crucial for restoring spinal stability and neurological function in tuberculosis cases [12, 13]. Several studies emphasize that careful placement of pedicle screws under guidance, including robotic assistance, enhances surgical outcomes and reduces complications [12]. This technique addresses spinal deformities and achieves sagittal alignment restoration, critical in tuberculosis management [13]. Furthermore, posterior instrumentation with pedicle screws has been validated biomechanically to withstand physiologic loads while preserving stability [14].

In many resource-limited settings, comprehensive data evaluating posterior-only approaches remain limited. Much of the available literature includes heterogeneous cohorts or combined anterior and posterior procedures, making focused assessment necessary [10, 15]. Therefore, systematic evaluation of posterior decompression and pedicle screw stabilization in thoracolumbar spinal tuberculosis is clinically warranted to clarify its effectiveness and safety profile.

The present study aimed to evaluate neurological recovery, pain reduction, radiological correction of kyphosis, postoperative complications and overall functional outcome following posterior decompression and stabilization by pedicle screw and rods in patients with thoracolumbar spinal tuberculosis.

2. Materials & Methods

This prospective interventional study was conducted in the Department of Orthopaedic Surgery, Dhaka Medical College Hospital, Bangladesh. The study period extended from July 2017 to June 2019. A total of 18 consecutive patients diagnosed with thoracolumbar spinal tuberculosis and treated surgically with posterior decompression and pedicle screw stabilization were included.

Sample Selection

2.1. Inclusion criteria

- Patients aged 16 to 75 years.
- Confirmed thoracolumbar spinal tuberculosis based on clinical and radiological findings.
- Presence of neurological deficit.
- Radiological evidence of spinal instability.
- Patients undergoing posterior decompression and pedicle screw fixation.

2.2. Exclusion criteria

- Patients managed conservatively without surgery.
- Tuberculosis involving the cervical or sacral spine exclusively.
- Patients with severe uncontrolled medical comorbidities.
- Patients were unwilling to participate or were lost before the initial postoperative assessment.

2.3. Data Collection Procedure

Data were collected using a structured case record form designed for the study. Detailed demographic information, occupational status and clinical presentation were recorded at admission. Neurological status was graded preoperatively using the American Spinal Injury Association (ASIA) grading system. Pain severity was evaluated using the Visual Analogue Scale (VAS). Radiological assessment included plain radiographs to measure the kyphotic angle preoperatively and postoperatively. All patients underwent posterior decompression and pedicle screw fixation under general anesthesia. Postoperative radiographs were obtained to confirm implant position and measure correction. Follow-up assessments were performed at 1, 3 and 6 months. Neurological

status, pain score, complications and functional outcome using modified Macnab criteria were documented at each visit. Data were cross-checked for completeness and consistency before entry into the database.

2.4. Ethical Consideration

Ethical approval was obtained from the Ethical Review Committee of Dhaka Medical College.

Written informed consent was obtained from each patient or legal guardian. Confidentiality was maintained through anonymized data coding. Participation was voluntary and patients were allowed to withdraw at any stage without affecting treatment.

2.5. Statistical Analysis

Data were analyzed using the Statistical Package for Social Sciences version 20.0. Continuous variables were expressed as mean and standard deviation. Categorical variables were presented as frequency and percentage. Preoperative and postoperative neurological status was compared using Fisher's exact test. A p-value less than 0.05 was considered statistically significant.

3. RESULTS

Table 1. *Demographic Characteristics of the Study Population (n = 18)*

Variable		Frequency (N)	Percent (%)
Age (years)	≤20	3	16.67
	21–30	6	33.33
	31–40	0	0
	41–50	5	27.77
	51–60	3	16.67
	>60	1	5.56
	Mean ± SD	39 ± 17.23	
Gender	Male	6	33.33
	Female	12	66.67
Occupational status	Manual worker	3	16.67
	Businessmen	2	11.11
	Service holder	4	22.22
	House wife	7	38.89
	Student	2	11.11

Table 1 shows 16.67% were age group ≤20 years, 33.33% were 21–30 years, 27.77% were 41–50 years, 16.67% were 51–60 years and 5.56% were more than 60 years. The average age was 39 years. Females were 66.67% and males were 33.33%. The most impacted occupational group was housewives (38.89%), followed by service holders (22.22%).

Table 2. *Distribution of Patients by Pre & Post Operative ASIA Grade (n = 18)*

ASIA Grade	Preoperative (n=18) N (%)	Postoperative (n=18) N (%)
Grade A	0 (00)	0 (00)
Grade B	6 (33.33)	0 (00)
Grade C	8 (44.44)	2 (11.11)
Grade D	4 (22.22)	7 (38.89)
Grade E	0 (00)	9 (50)
Total	18 (100)	18 (100)

Table 2 shows the distribution of patients by pre & post operative ASIA Grade. Neurological status was assessed preoperatively and postoperatively using the ASIA grading system. Maximum 44.44% were grade C in the preoperative state, followed by 33.33% grade B and 22.22% grade D. No patient was grade A or E preoperatively. Postoperatively, 50% achieved grade E.

Table 3. *Pre and Post-operative Pain Evaluation by VAS (n = 18)*

Parameter	Pre-operative (n=18) Mean ± SD	Post-operative (n=18) Mean ± SD	p value
VAS	6.94 ± 0.49	2.33 ± 0.57	<0.001

Table 3 shows the pre- and post-operative pain evaluation by VAS. Pain intensity was assessed using the Visual Analogue Scale. The mean preoperative VAS score was 6.94 ± 0.49 and decreased to 2.33 ± 0.57 postoperatively. The mean difference between preoperative and postoperative VAS score was statistically significant.

Table 4. *Pre and Post Operative K Angle (n = 18)*

Parameter	Pre op K angle Mean ± SD (Degree)	Post op K angle Mean ± SD (Degree)
K angle	28.7 ± 4.5	12.5 ± 3.5

Table 4 present the pre and post operative K Angle score. Radiological evaluation was performed using Cobb's method to measure kyphotic angle preoperatively and postoperatively. The mean preoperative kyphotic angle was 28.7 ± 4.5 degrees and the mean postoperative kyphotic angle was 12.5 ± 3.5 degrees.

Table 5. *Distribution of Patients by Post Operative Complications (n = 18)*

Post operative complications	Frequency (N)	Percentage (%)
Postoperative wound infection	1	5.56
No complication	17	94.44
Total	18	100

Table 5 shows that out of 18 patients, 1 patient (5.56%) developed postoperative superficial wound infection which recovered with regular dressing and antibiotic medication. The remaining 17 (94.44%) had no complications.

Table 6. *Distribution of the Patients by Functional Outcome According to Modified Macnab Criteria (n = 18)*

Results	Frequency	Percentage (%)
Excellent	14	77.77
Good	3	16.67
Fair	1	5.56
Poor	0	0
Total	18	100

Table 6 shows that majority (77.77%) of the patients had excellent outcome followed by 16.67% good outcome and 5.56% fair outcome. Satisfactory result, defined as excellent and good categories combined, was achieved in 94.44% of patients.

4. Discussion

The present study evaluated the clinical and radiological outcomes of posterior decompression and pedicle screw stabilization in thoracolumbar spinal tuberculosis. The results demonstrate significant neurological recovery, substantial pain reduction, meaningful correction of kyphotic deformity and a low complication rate.

The demographic profile revealed a mean age of 39 years with a predominance in the 21–30-year age group. This finding reflects the tendency of spinal tuberculosis to affect young and economically productive individuals in endemic regions. Rasouli et al. reported a similar age distribution in their systematic review, highlighting the socioeconomic implications of spinal tuberculosis [8]. The female predominance observed in this series is consistent with regional data where sociocultural determinants may influence disease presentation and healthcare access [2].

Neurological recovery remains the primary objective of surgical intervention. In this study, most patients presented with incomplete neurological deficits, predominantly grade C. Postoperatively, 50% achieved grade E and none deteriorated neurologically. Zhang et al. reported comparable improvement in ASIA grades following posterior-only debridement and instrumentation in thoracolumbar tuberculosis [10]. Similarly, Alam et al. demonstrated significant neurological improvement after posterior stabilization, emphasizing the adequacy of decompression achieved through the posterior approach [15]. The absence of postoperative neurological worsening in this cohort supports the safety of the technique.

Pain relief was significant, with mean VAS decreasing from 6.94 to 2.33. Severe pain in spinal tuberculosis often results from instability and inflammatory involvement of vertebral structures. Surgical stabilization reduces pathological motion and alleviates mechanical stress. Garg and Somvanshi observed that instrumented stabilization provides early symptomatic improvement when compared to conservative treatment alone [4]. The magnitude of pain reduction in the present series is consistent with outcomes reported in surgically managed tuberculous spondylitis [11].

Kyphotic deformity is a major concern in thoracolumbar tuberculosis. The mean kyphotic angle improved from 28.7 degrees preoperatively to 12.5 degrees postoperatively. Rajasekaran emphasized that progressive kyphosis can lead to late neurological compromise if left uncorrected [7]. Posterior pedicle screw constructs allow segmental fixation and controlled deformity correction. Ahsan et al. documented sustained kyphotic correction following posterior instrumentation, with minimal loss during follow-up [11]. The correction achieved in this study demonstrates the biomechanical effectiveness of pedicle screw fixation in restoring sagittal alignment.

The complication profile was favorable, with only one superficial wound infection that resolved with conservative management. There were no cases of implant failure or neurological deterioration. Historically, instrumentation in infected fields was approached cautiously. However, Chen et al. demonstrated that with adequate debridement and appropriate chemotherapy, instrumentation does not increase infection-related complications [9]. The low complication rate in this study aligns with contemporary evidence supporting the safety of posterior fixation in active spinal tuberculosis.

Functional outcome assessed by modified Macnab criteria showed that 94.44% of patients achieved satisfactory results. Functional recovery integrates neurological improvement, pain control and mechanical stability. Jain emphasized that the success of surgical treatment in spinal tuberculosis should be measured by restoration of daily functional capacity rather than radiological parameters alone [6]. The high proportion of excellent and good outcomes observed in this study indicates that posterior decompression and stabilization effectively achieve these therapeutic goals.

Overall, the findings suggest that posterior decompression with pedicle screw and rod fixation is an effective and safe surgical modality for thoracolumbar spinal tuberculosis presenting with neurological deficit or instability.

5. Conclusion

Posterior decompression and pedicle screw stabilization in thoracolumbar spinal tuberculosis result in significant neurological improvement, marked pain reduction, effective correction of kyphotic deformity and high rates of satisfactory functional outcome. The procedure demonstrates a low complication rate and provides reliable stabilization, supporting its role as an effective surgical option in appropriately selected patients.

Conflicts Of Interest

There are no conflicts of interest.

Ethical Approval

This study approved by the ethical review committee of Dhaka Medical College.

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