DOI: https://dx.doi.org/10.18203/issn.2455-4510.IntJResOrthop20261206

Original Research Article

Functional and radiological outcomes after posterior decompression and pedicle screw stabilization in thoracolumbar spinal tuberculosis

M. Hamidul Haque[1]*, M. Shahidul Islam Akon[2], M. Kamruzzaman[1], M. Shafiul Ezaz[1], Abdullah Al Mahmud[1], Khandaker Aziz Abdullah Nabil[1], M. Solaiman Hasan[1], M. Nurullah[1]

[1]Department of Orthopaedic Surgery, IBN Sina Medical College, Dhaka, Bangladesh
[2]Department of Orthopaedic Surgery, Dhaka Medical College, Dhaka, Bangladesh

Received: 10 March 2026
Revised: 14 April 2026
Accepted: 18 April 2026

***Correspondence:**
Dr. M. Hamidul Haque,
E-mail: drrasheddmc@gmail.com

ABSTRACT

Background: Tuberculosis (TB) remains a major global health concern, and spinal TB (Pott's disease) is the most common and severe form of skeletal tuberculosis, frequently involving the thoracolumbar region and potentially leading to neurological deficit, deformity, and functional impairment. Therefore, this study aimed to evaluate the functional and radiological outcomes of posterior decompression with pedicle screw stabilization in patients with thoracolumbar spinal tuberculosis.

Methods: This prospective interventional study at the Department of Orthopaedic Surgery, Dhaka Medical College Hospital, Dhaka, Bangladesh (July 2017–June 2019) included 18 patients with thoracolumbar spinal tuberculosis who underwent posterior decompression and pedicle screw fixation, with pre- and postoperative evaluation using ASIA grading, radiographs, and Modified Macnab criteria; data were analyzed with SPSS v20.0 ($p < 0.05$).

Results: Among 18 patients, most were 21–30 years (6,33.3%) and female (12,66.7%). Lesions were mainly dorsal (11, 61.1%) and lumbar (6,33.3%). Postoperative complications were rare (1, 5.6%). Neurological recovery improved (ASIA E: 9, 50%), normal ambulation in 11 (61.1%), VAS decreased 6.94→2.33, Cobb angle 28.7°→12.5°, and 17 (94.4%) achieved satisfactory functional outcomes.

Conclusions: Posterior decompression with pedicle screw stabilization is a safe and effective approach that provides significant neurological, functional, and radiological improvement in thoracolumbar spinal tuberculosis.

Keywords: Thoracolumbar spinal tuberculosis, Posterior decompression, Pedicle screw stabilization

INTRODUCTION

Tuberculosis (TB) continues to impose a major public health challenge, particularly in low- and middle-income countries, whereas its incidence has declined in developed nations due to improvements in sanitation, nutrition, and overall hygiene, even before the advent of antitubercular therapy (ATT). Despite this, spinal TB has been increasingly reported in developed regions, largely attributed to the rising prevalence of human immunodeficiency virus (HIV)/ acquired immunodeficiency syndrome, immigration, and longer survival of immunocompromised individuals. Globally, TB caused approximately 1.4 million deaths in 2014, underscoring its ongoing public health significance.[1] Spinal TB, also known as Pott's disease, represents the most frequent and severe manifestation of skeletal tuberculosis, accounting for nearly half of all

osteoarticular TB cases.[1] The thoracolumbar junction is the most frequently affected region, although any segment of the spine can be involved.[2] Lower thoracic and lumbar vertebrae are predominantly affected, followed by the middle thoracic and cervical regions. Pott disease may initially present independently but often occurs secondary to pulmonary or abdominal TB.[3,4]

Spinal TB presents considerable diagnostic and therapeutic challenges and carries a high risk of serious morbidity, permanent neurological deficits, and marked spinal deformities.[3] It can lead to vertebral destruction, severe kyphotic deformity, and paraplegia.[5] Neurological compromise commonly arises from compression of the spinal cord or nerve roots due to a tubercular epidural abscess.[6] Although conventional chemotherapy achieves high cure rates in skeletal TB, surgical intervention becomes necessary in the presence of early neurological deficits or progressive deterioration.[7] These complications not only threaten patients' physical health but also substantially impair functional independence and overall quality of life.

Most patients can be managed effectively with either medical therapy alone or a combination of medical and surgical approaches, with optimal outcomes reliant on early diagnosis and appropriately timed surgical intervention.[8,9] Treatment strategies range from conservative management using ATT to more invasive procedures, including anterior-only or combined anterior-posterior surgeries.[3] Posterior instrumentation has gained recognition as a preferred surgical method in thoracolumbar and lumbar TB, providing three-column stabilization and circumferential decompression while minimizing morbidity.[9-11] The posterior extrapleural approach enables access to both anterior and lateral spinal columns, facilitating thorough decompression of neural elements and allowing extension to multiple vertebral levels above and below the diseased site.[5,12] Compared to combined anterior-posterior procedures, this approach reduces operative time, intraoperative blood loss, and overall morbidity. In the present study, we employed a posterolateral approach with pedicle screws and rods for posterior decompression and stabilization.[13]

The choice of an optimal surgical approach for thoracolumbar TB remains debated. Surgical objectives include adequate decompression, thorough debridement, restoration and reinforcement of spinal stability, and correction or prevention of deformity.[12,13] Traditionally, anterior debridement and reconstruction were considered the gold standard; however, improvements in imaging have enabled earlier detection, permitting less invasive approaches to achieve similar therapeutic outcomes.[9] The anterior approach is associated with longer operative times, increased blood loss, extended hospitalization, graft failure, loss of correction, and residual kyphosis at treatment completion.[14] In contrast, the posterior approach, applying the same principles, has demonstrated lower complication rates and growing clinical acceptance.[11-14]

These considerations underscore the importance of further assessing functional and radiological outcomes following posterior decompression and pedicle screw stabilization in thoracolumbar spinal tuberculosis. Therefore, this study aimed to evaluate the functional and radiological outcomes of posterior decompression with pedicle screw stabilization in patients with thoracolumbar spinal tuberculosis.

METHODS

This prospective interventional study was conducted at the Department of Orthopaedic Surgery, Dhaka Medical College Hospital, Dhaka, Bangladesh, between July 2017 and June 2019. A total of 18 patients with thoracolumbar spinal tuberculosis, aged 16–75 years and of both sexes, were included. Patients were selected based on predefined inclusion and exclusion criteria to evaluate the functional and radiological outcomes of posterior decompression with pedicle screw stabilization.

Inclusion criteria

The study included patients with thoracolumbar spinal tuberculosis presenting with neurological involvement such as paraplegia, complete loss of motor power, or spasticity. Individuals aged 16–75 years of either sex were considered eligible, provided they had an unstable spine resulting from tuberculosis.

Exclusion criteria

Patients were excluded if they were managed conservatively without surgical intervention, had significant comorbidities that increased the risk of surgery, or had tuberculosis involving spinal regions other than the thoracolumbar spine.

Ethical approval was obtained from the Ethical Review Committee of Dhaka Medical College, and informed consent was obtained from all patients or guardians. Preoperatively, detailed history, physical, and neurological examinations were performed, and all patients received standard antitubercular therapy for 12 months. Surgical management included posterior decompression and pedicle screw fixation under general anesthesia in the prone position, with vertebral levels identified radiologically, pedicle screws inserted two levels above and below the affected vertebrae under C-arm guidance, posterior decompression performed, and titanium rods fixed to restore spinal alignment; wounds were closed in layers with a drain. Postoperatively, patients were monitored for vital signs, neurological status, and drain output, with ambulation using a brace initiated from day 3–5. Follow-up at 1, 3, and 6 months included clinical and neurological assessments using ASIA grading, radiographs for fusion and instrumentation evaluation, and functional outcome assessment using Modified Macnab criteria, with excellent/good considered satisfactory and fair/poor unsatisfactory. Data were collected using a

structured form and analyzed using SPSS version 20.0, with continuous variables expressed as mean±SD, categorical variables as frequencies and percentages, and statistical significance determined by Fisher's exact test ($p<0.05$).

RESULTS

The age distribution showed that the largest proportion of patients belonged to the 21–30 years age group (6 patients, 33.3%), followed by those aged 41–50 years (5 patients, 27.8%). Patients aged ≤20 years and 51–60 years each accounted for 3 cases (16.7%), while only 1 patient (5.6%) was older than 60 years. Female patients predominated in the study population (12 patients, 66.7%), whereas male patients accounted for 6 cases (33.3%).

Table 1: Distribution of patients by age (n=18).

Age in years	Frequency	Percentage (%)
≤20	3	16.7
21–30	6	33.3
31–40	0	0.0
41–50	5	27.8
51–60	3	16.7
>60	1	5.6
Total	18	100.0

The dorsal spine was the most commonly affected region (11 patients, 61.1%), followed by the lumbar spine (6 patients, 33.3%) and the dorsolumbar junction (1 patient, 5.6%). Regarding specific vertebral levels, D9–D10 and L1–L2 were the most frequently involved segments (3 patients each, 16.7%), while several other levels such as D6–D7, D10–D11, and D11–D12 each accounted for 2 cases (11.1%).

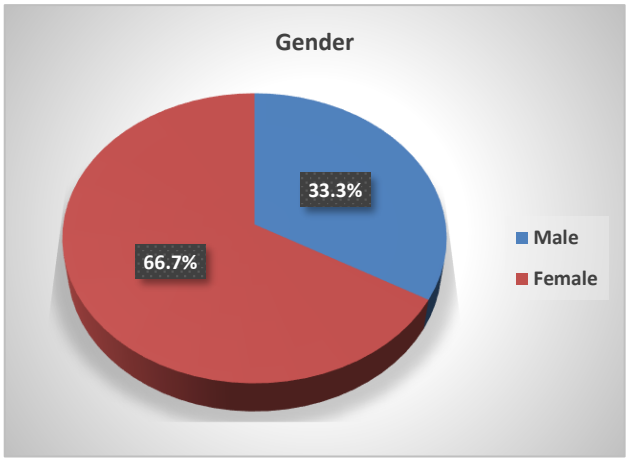

Figure 1: Distribution of patients by gender (n=18).

Postoperative complications were minimal in the present study. The majority of patients (17 patients, 94.4%) experienced no complications, while only 1 patient (5.6%) developed a superficial wound infection. Neurological status showed marked improvement following surgery. Preoperatively, most patients were classified as ASIA Grade C (8 patients, 44.4%) and Grade B (6 patients, 33.3%), while 4 patients (22.2%) were Grade D. Postoperatively, neurological recovery was evident, with 9 patients (50.0%) improving to Grade E and 7 patients (38.9%) to Grade D, while only 2 patients (11.1%) remained in Grade C.

Table 2: Distribution of patients by level and location of lesion involvement (n=18).

Parameter	Location	Frequency	Percentage (%)
Level of involvement	Dorsal	11	61.1
	Lumbar	6	33.3
	Dorsolumbar	1	5.6
Location of involvement	D6–D7	2	11.1
	D9–D10	3	16.7
	D9,D10,D12	1	5.6
	D10–D11	2	11.1
	D11–D12	2	11.1
	D10,D11,D12	1	5.6
	D12–L1	1	5.6
	L1–L2	3	16.7
	L2–L3	1	5.6
	L3–L4	1	5.6
	L4–L5	1	5.6

Ambulatory ability improved substantially after surgery. Preoperatively, the majority of patients were bedridden (11 patients, 61.1%), while 4 patients (22.2%) could walk without support despite some weakness and 3 patients (16.7%) required support for ambulation. Postoperatively, 11 patients (61.1%) regained normal walking ability, while only 1 patient (5.6%) remained bedridden. Pain severity improved significantly following surgical intervention. The mean preoperative VAS score was 6.94±0.49, which decreased to 2.33±0.57 postoperatively, demonstrating a statistically significant reduction in back pain ($p < 0.001$). Radiological assessment showed a significant correction

of spinal deformity following surgery. The mean preoperative Cobb angle was 28.7°±4.5°, which improved to 12.5°±3.5° postoperatively. Functional outcomes were favorable in the majority of patients.

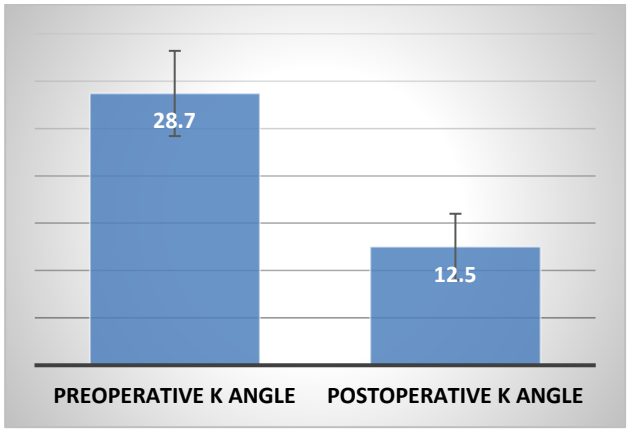

Figure 2: Comparison of pre- and postoperative cobb angle (n=18).

Table 3: Distribution of patients by postoperative complications (n=18).

Postoperative complications	Frequency	Percentage (%)
Postoperative wound infection	1	5.6
No complication	17	94.4
Total	18	100.0

Table 4: Distribution of patients by pre- and postoperative ASIA grade (n=18).

ASIA grade	Preoperative N (%)	Postoperative N (%)
Grade A	0 (0.0)	0 (0.0)
Grade B	6 (33.3)	0 (0.0)
Grade C	8 (44.4)	2 (11.1)
Grade D	4 (22.2)	7 (38.9)
Grade E	0 (0.0)	9 (50.0)
Total	18 (100.0)	18 (100.0)

Table 5: Distribution of patients by pre- and postoperative ambulatory status (n=18).

Ambulation	Preoperative N (%)	Postoperative N (%)
Normal walking	0 (0.0)	11 (61.1)
Some weakness but can walk without support	4 (22.2)	4 (22.2)
Walks with support	3 (16.7)	2 (11.1)
Bedridden	11 (61.1)	1 (5.6)
Total	18 (100.0)	18 (100.0)

Table 6: Comparison of pre- and postoperative vas scores for back pain (n=18).

	Mean±SD
Preoperative	6.94±0.49
Postoperative	2.33±0.57
P value	<0.001

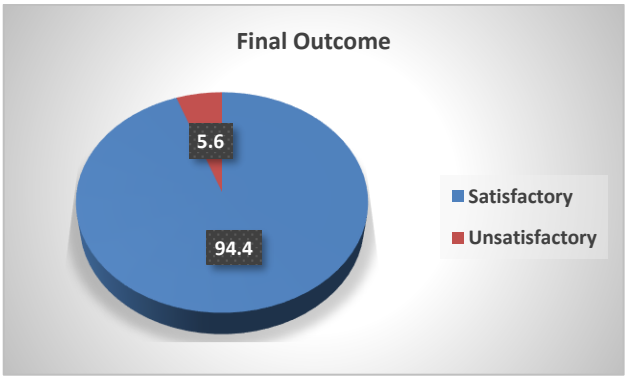

Figure 3: Distribution of patients by final outcome (n=18).

Table 7: Distribution of patients by functional outcome according to modified MACNAB criteria (n=18).

Functional outcome	Frequency	Percentage (%)
Excellent	14	77.8
Good	3	16.7
Fair	1	5.6
Poor	0	0.0
Total	18	100.0

Excellent results were observed in 14 patients (77.8%), good outcomes in 3 patients (16.7%), and fair outcomes in 1 patient (5.6%), with no patients demonstrating poor outcomes. Overall outcomes were satisfactory in most cases. A satisfactory outcome (excellent and good) was achieved in 17 patients (94.4%), while only 1 patient (5.6%) had an unsatisfactory outcome.

DISCUSSION

In this prospective study conducted at Dhaka Medical College Hospital, the functional and radiological outcomes of posterior decompression with pedicle screw stabilization were evaluated in patients with thoracolumbar spinal tuberculosis. The findings demonstrated significant improvement in neurological status, pain relief, and ambulatory capacity following surgical intervention. In addition, radiological assessment revealed effective correction of kyphotic deformity and stabilization of the affected spinal segments. These results highlight the role of posterior decompression with pedicle screw stabilization as an effective surgical approach for

achieving favorable clinical and radiological outcomes in patients with thoracolumbar spinal tuberculosis.

In the present study, the majority of patients with thoracolumbar spinal tuberculosis were young and middle-aged adults, with the highest proportion in the 21–30-year age group (33.3%), followed by 41–50 years (27.8%), and smaller proportions in the ≤20 years, 51–60 years, and >60 years categories. This age distribution aligns with previous literature, where spinal tuberculosis predominantly affects younger and middle-aged populations. Nandra et al, who investigated the epidemiology of spinal tuberculosis in a rural tertiary care center, reported a mean age of 40–44 years across multiple centers, reflecting a comparable demographic pattern and supporting the observation that thoracolumbar spinal tuberculosis commonly presents in early to mid-adulthood.[15]

In this study, female patients predominated, accounting for 12 cases (66.7%) compared to 6 male patients (33.3%). This gender distribution is consistent with other reports on spinal tuberculosis, where a slight female predominance has been observed. Ifthekar et al, in a cross-sectional study of 286 spinal tuberculosis patients, reported 54.96% female and 46.1% male patients, supporting the observation that thoracolumbar spinal tuberculosis may more commonly affect women in certain populations.[16] The higher proportion of female patients in our cohort may reflect demographic or regional variations in disease presentation.

Regarding lesion distribution, the majority of lesions were located in the dorsal spine (61.1%), followed by the lumbar (33.3%) and dorsolumbar (5.6%) regions, with D9–D10 and L1–L2 being the most frequently affected levels (16.7% each). These findings are consistent with Hassan et al, who described patients treated with transpedicular fixation via a posterior approach and found that thoracolumbar involvement, particularly in the dorsal and lumbar segments, was common, with dorsal lesions predominating.[17] The similarity in lesion distribution emphasizes that the dorsal and adjacent lumbar regions are the most frequently affected sites in thoracolumbar spinal tuberculosis, which has important implications for surgical planning, including decompression levels and fixation strategies.

Postoperative complications were minimal in our cohort, with only 1 patient (5.6%) developing a superficial wound infection, while the remaining 17 patients (94.4%) experienced no adverse events. This low complication rate is consistent with the findings of Ahmad et al, who evaluated posterior decompression and pedicle screw fixation in patients with thoracolumbar spinal tuberculosis and reported that postoperative infections and hardware-related complications occurred in only a small proportion of cases.[18] These results underscore the favorable safety profile of the posterior approach for thoracolumbar spinal tuberculosis.

Neurological outcomes showed significant improvement following posterior decompression and pedicle screw stabilization. Preoperatively, most patients were classified as ASIA Grade B (33.3%) and Grade C (44.4%), with 22.2% in Grade D. Postoperatively, 50.0% of patients achieved Grade E and 38.9% were in Grade D, indicating marked recovery. Haq et al, who assessed the use of decompression and transpedicular fixation in thoracic spine tuberculosis, reported that neurological deficits improved in a large proportion of patients based on ASIA grading, supporting the observation that posterior pedicle screw stabilization facilitates substantial recovery of neurological function in thoracolumbar spinal tuberculosis.[19]

Ambulatory status also improved significantly. Preoperatively, 61.1% of patients were bedridden, 22.2% could walk without support despite some weakness, and 16.7% required support for ambulation. Postoperatively, 61.1% regained normal walking ability, 22.2% could walk without support, and only 5.6% remained bedridden. These findings align with Ahmad et al, who reported that posterior pedicle fixation facilitates early mobilization, reduces complications associated with prolonged bed rest, and accelerates functional recovery, highlighting the benefits of posterior stabilization for improving postoperative mobility and independence.[18]

Back pain improved markedly following surgery. The mean preoperative VAS score of 6.94±0.49 decreased to 2.33±0.57 postoperatively ($p<0.001$), reflecting substantial pain relief. Bihari et al, who evaluated posterior approach debridement, decompression, and stabilization with pedicle screw fixation for thoracolumbar spinal tuberculosis, similarly reported a reduction in mean VAS scores from 6.0±1.5 preoperatively to 2.5±0.9 postoperatively, emphasizing that posterior stabilization effectively alleviates pain while providing structural support and neural decompression.[20]

Radiological assessment demonstrated significant correction of spinal deformity. The mean preoperative Cobb angle of 28.7°±4.5° improved to 12.5°±3.5° postoperatively. Ligu et al, who evaluated debridement and stabilization with transpedicular screws in thoracolumbar spinal tuberculosis, reported comparable improvements in kyphotic Cobb angles following posterior decompression and fixation.[21] These findings confirm that posterior approaches not only achieve neural decompression and stabilization but also correct kyphotic deformities, enhancing both functional and radiological outcomes.

Functional outcomes were highly favorable according to the Modified Macnab criteria. In the present study, 77.8% of patients achieved excellent outcomes, 16.7% good outcomes, and only 5.6% fair outcomes, with no poor results observed. These results mirror those of Islam et al, who evaluated decompression and transpedicular screw fixation in thoracolumbar spinal tuberculosis and reported

a high proportion of excellent and good outcomes among treated patients.[22] Kalanjiyam et al, in a prospective study comparing posterior surgical techniques for thoracolumbar spinal tuberculosis, similarly reported high rates of excellent or good functional outcomes following posterior-only approaches including pedicle screw stabilization.[23] Together, these studies demonstrate that posterior decompression combined with pedicle screw fixation consistently yields excellent to good functional recovery in thoracolumbar spinal tuberculosis.

Finally, overall outcomes were highly satisfactory in the present study, with 94.4% achieving a satisfactory outcome (excellent or good) and only 5.6% experiencing an unsatisfactory outcome. Ahmad et al, in a study evaluating decompression and posterior stabilization with pedicle screw fixation, reported similarly favorable outcomes, confirming the posterior pedicle screw approach as safe, effective, and associated with good clinical results.[18] Kalanjiyam et al also supported the reliability of posterior-only surgical strategies in producing satisfactory functional and neurological outcomes.[23] Collectively, these findings underscore that posterior decompression with pedicle screw stabilization is a dependable and effective surgical approach for managing thoracolumbar spinal tuberculosis, providing improvements in pain, neurological function, mobility, spinal alignment, and overall functional recovery.

Limitations

The study is limited by a small sample size, which restricts the generalizability of its findings. Additionally, the relatively short follow-up period limits the ability to assess long-term outcomes. Furthermore, the high cost of implants may affect accessibility and reduce the wider applicability of the procedure.

CONCLUSION

Thoracolumbar spinal tuberculosis is a debilitating condition that can cause neurological deficits, spinal deformity, and functional impairment. In this study, posterior decompression with pedicle screw stabilization demonstrated excellent clinical, functional, and radiological outcomes. Lesions were predominantly located in the dorsal and lumbar regions, and postoperative complications were minimal. Significant neurological recovery was observed, with most patients improving to higher ASIA grades. Ambulatory ability improved markedly, and patients reported substantial pain relief. Radiological correction was achieved with restoration of spinal alignment, and functional outcomes were favorable, with the majority achieving excellent or good results. These findings indicate that posterior decompression with pedicle screw stabilization is a safe, effective, and reliable surgical approach for managing thoracolumbar spinal tuberculosis, providing improvements in pain, function, neurological status, and spinal stability.

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: Haque MH, Akon MSI, Kamruzzaman M, Ezaz MS, Mahmud AA, Nabil KAA, et al. Functional and radiological outcomes after posterior decompression and pedicle screw stabilization in thoracolumbar spinal tuberculosis. Int J Res Orthop 2026;12:590-6.