

Neurological Variability in Multilevel Cervical Tuberculous Spondylitis: A Comparative Two-Case Analysis

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ABSTRACT

Background: Cervical tuberculous spondylitis is an uncommon but potentially devastating form of spinal tuberculosis, associated with a high risk of neurological impairment due to the narrow cervical spinal canal and proximity to vital neurovascular structures. Variability in neurological presentation and recovery remains clinically significant, particularly in young patients with multilevel disease. **Case Presentation:** Two adolescent males with multilevel cervical tuberculous spondylitis managed at the same center. The first patient, aged 17 years, presented after six months of progressive neck pain with advanced tetraparesis, sphincter dysfunction, and extensive destruction of C2–C4 vertebrae causing severe spinal cord compression and intramedullary edema. The second patient, aged 18 years, presented after three months of neck pain with progressive upper limb paresis without autonomic involvement, associated with C2–C5 vertebral involvement and marked kyphotic deformity. Both patients underwent anterior cervical corpectomy and fusion with debridement and stabilization, followed by a 12-month anti-tuberculous regimen and structured rehabilitation. At six months follow-up, the first patient achieved complete neurological recovery (MRC 5/5), whereas the second demonstrated substantial improvement with mild residual upper motor neuron signs (MRC 4/5). **Discussion:** Despite comparable multilevel involvement and radiological severity, the cases exhibited distinct neurological patterns and recovery trajectories. The comparison underscores the heterogeneity of cervical spinal tuberculosis and highlights the importance of prompt decompression after onset of myelopathy. Factors such as degree of cord compression, extent of edema, and reconstructive strategy may influence neurological outcomes. **Conclusion:** Multilevel cervical tuberculous spondylitis in adolescents can present with variable neurological deficits and differing recovery profiles. Careful clinical assessment and timely surgical decompression with stabilization can result in favorable functional outcomes. Comparative analysis of similar cases may provide insight into prognostic determinants in cervical spinal tuberculosis.

Keyword : Cervical spine tuberculosis; Tuberculous spondylodiscitis; Anterior cervical corpectomy; Neurological deficit; Spinal cord compression.

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INTRODUCTION

Tuberculosis (TB) remains a major global health challenge, ranking among the leading causes of infectious morbidity and mortality worldwide. According to the Global tuberculosis report 2025, millions of new cases continue to be reported annually, with a substantial proportion occurring in low and middle income countries. Although pulmonary tuberculosis is the most common presentation, extrapulmonary involvement

accounts for a significant disease burden, particularly in endemic regions.¹

Spinal tuberculosis is the most frequent form of skeletal tuberculosis and represents a serious manifestation of extrapulmonary TB. The disease typically involves the anterior vertebral elements and intervertebral discs, leading to progressive bone destruction, abscess formation, spinal instability, and potential neurological compromise. Pathophysiologically, hematogenous spread of

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Mycobacterium tuberculosis to the vertebral bodies results in caseation necrosis and collapse, which may subsequently cause deformity and cord compression.²

Recent updates in spinal tuberculosis management emphasize advances in diagnostic imaging, molecular confirmation, and surgical techniques, contributing to improved outcomes when timely intervention is implemented.³ Despite these advances, cervical spine involvement remains relatively uncommon compared to thoracic and lumbar regions. However, cervical tuberculous spondylitis is associated with disproportionately high morbidity due to the narrow spinal canal, proximity to the brainstem, and risk of catastrophic neurological deterioration.⁴

Cervical spinal tuberculosis often presents with neck pain, progressive kyphotic deformity, paravertebral abscess, and varying degrees of myelopathy. Neurological deficits may range from mild upper motor neuron signs to complete tetraplegia, depending on the extent and duration of spinal cord compression.^{4,5} A recent systematic review and meta-analysis highlights the heterogeneity of clinical presentation and emphasizes the importance of early recognition of neurological deterioration and appropriate surgical intervention in selected patients.⁵

Management strategies for subaxial cervical tuberculosis continue to evolve. While anti-tuberculous agents remains the cornerstone of treatment, surgical intervention is indicated in cases of neurological deficit, mechanical instability, progressive deformity, or failure of conservative management.^{4,6} A systematic review focusing on subaxial cervical spine tuberculosis supports the role of anterior decompression and reconstruction in achieving satisfactory neurological recovery and deformity correction when combined with adequate anti-tuberculous therapy.⁶

Given the rarity and potential severity of cervical tuberculous spondylitis, further clinical documentation and comparative analyses are essential to better understand variations in presentation and recovery patterns. In this report, we present a comparative analysis of two adolescent patients with multilevel cervical tuberculous spondylitis managed at the same institution, aiming to explore differences in neurological manifestation and outcome.

CASE PRESENTATION

Case 1 (Previously Published)

Case 1 was previously reported by Septika et al.⁷ A previously published case from our institution described a 17-year-old male who presented with a six-month history of progressive neck pain followed by rapidly evolving tetraparesis over two weeks. Neurological examination demonstrated significant motor weakness in all extremities with upper motor neuron signs and subsequent development of sphincter dysfunction.

Imaging revealed extensive destruction of the C2–C4 vertebral bodies, most pronounced at C3, with anterior epidural compression of the spinal cord. Magnetic resonance imaging showed multilevel vertebral involvement, a sizeable paravertebral abscess, epidural extension, and intramedullary edema, consistent with advanced cervical tuberculous spondylitis.⁷

The patient underwent anterior cervical debridement with C3 corpectomy and anterior column reconstruction using autologous iliac crest bone graft and plate fixation from C2 to C4. A 12-month course of anti-tuberculous agents was administered postoperatively. Progressive neurological improvement was observed, and complete motor recovery was achieved at six months, with restoration of independent daily functioning and satisfactory radiological alignment.⁷

Case 2 (Current Case)

History of Present Illness

An 18-year-old male presented with a three-month history of severe neck pain radiating to both shoulders with numerical rating scale (NRS) score 9. Three weeks before admission, he developed progressive weakness of the right upper limb, followed by left upper limb weakness one week later. Two weeks prior to admission, he noticed numbness below the chest. There was no history of trauma, fever, chronic cough, night sweats, or prior tuberculosis.

On examination, he appeared underweight with a body mass index of 15.57 kg/m². Neurological examination revealed upper limb motor strength of 3/3, normal lower limb strength (5/5) based on the Medical Research Council (MRC) scale, hypoesthesia below the C5 dermatome, increase deep tendon reflexes (+3), and positive Hoffman and Tromner signs bilaterally. These findings were consistent with paresis of upper motor neuron type.

Preoperative plain cervical anteroposterior and lateral radiographs demonstrated collapse of the C4 vertebral body with a local kyphotic angulation of

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approximately 31 degrees. There was associated erosion of the inferior endplate of C3 and the superior endplate of C5. The retropharyngeal space was markedly widened, measuring 20 mm (normal range: 1–7 mm). The retrotracheal space measured 11.2 mm (normal range: 9–22 mm) (Fig 1). Anti-tuberculous regiment therapy was given and philadelphia cervical collar was applied for external immobilization.

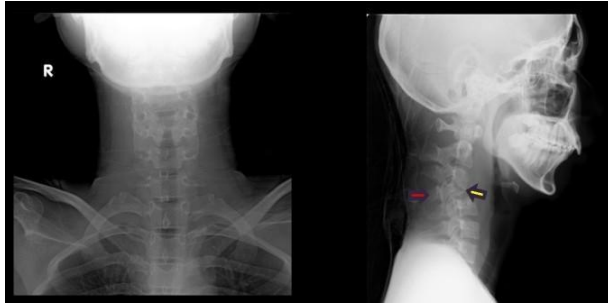


Figure 1: Pre-operative cervical x-ray anteroposterior and lateral view. Collapse of the C4 vertebral body with a local kyphotic angulation of approximately 31° (red arrow), accompanied by erosion of the inferior endplate of C3 and the superior endplate of C5 (yellow arrows). These findings are consistent with cervical tuberculous spondylitis with segmental instability and prevertebral soft tissue involvement.

MRI cervicothoracic spine showed collapse of the C4 vertebral body involving the C4–C5 intervertebral disc, resulting in a kyphotic deformity of approximately 36° with posterior listhesis. A paravertebral mass measuring approximately 2.5 × 4.0 × 3.7 cm was identified extending from C2 to C5. The lesion appeared heterogeneously mildly hyperintense relative to muscle on both T1- and T2-weighted images, with areas of restricted diffusion on DWI. Post-contrast sequences revealed peripheral rim enhancement, consistent with abscess formation.

The lesion extended into the vertebral bodies and pedicles from C2 to C5, involved the C3–C4 and C4–C5 intervertebral discs, and showed epidural extension from C2 to C5, causing severe central canal stenosis and compression of the spinal cord at levels C3 to C5 with associated myelopathy. MR myelography demonstrated obstruction of cerebrospinal fluid flow at the C3–C4 level. These MRI findings are consistent with cervical tuberculous spondylodiscitis complicated by extensive abscess formation from C2 to C5, with epidural

extension, spinal cord compression and myelopathy (Fig 2).

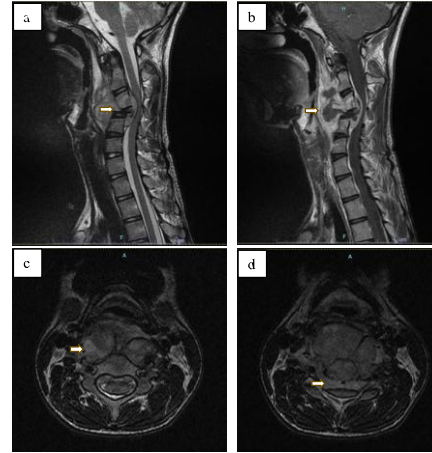


Figure 2: (a) T2-Weighted images cervical MRI in sagittal view demonstrating collapse of the C4 vertebral body (white arrow) with involvement of the C4–C5 intervertebral disc, kyphotic deformity (36°), and posterior listhesis, with hyperintense intramedullary signal on T2-weighted images from C3 to C5 indicating myelopathy. (b) Post-contrast sagittal T1-weighted image showing a heterogeneously rim-enhancing paravertebral abscess measuring approximately 2.5 × 4.0 × 3.7 cm extending from C2 to C5, with intraosseous extension into the vertebral bodies and pedicles (white arrow). (c) Contrast-enhanced axial MRI demonstrating paravertebral and epidural extension of the abscess (white arrow), causing severe central canal stenosis and compression of the spinal cord at the C3–C4 level. (d) Axial T2-weighted image showing intramedullary hyperintensity of the cervical spinal cord consistent with edema/myelopathy secondary to compression (white arrow).

The patient underwent surgical management consisting of debridement, anterior cervical corpectomy and fusion (ACCF) at the C4 level. Anterior cervical approach was used with a longitudinal incision. Corpectomy of C4 was performed, along with discectomy of the inferior endplate of C3 and the superior endplate of C5. Reconstruction was achieved using an anterior cervical plate (ACP) measuring 37.5 mm, a mesh cage (12 mm diameter, 3 cm length), and four screws (4.0 × 16 mm), followed by placement of bone graft.

Intraoperative specimens, including cervical soft tissue and swab samples, were sent for

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microbiological and molecular analysis. GeneXpert testing detected *Mycobacterium tuberculosis* with rifampicin sensitivity. Histopathological examination revealed chondroid and connective tissue fragments with dense infiltration of lymphocytes, histiocytes, and plasma cells, consistent with chronic granulomatous inflammation. Postoperative cervical radiographs demonstrated stable anterior fixation with plate-and-screw constructs in proper position, along with restoration of the normal cervical lordotic alignment (Fig. 3).

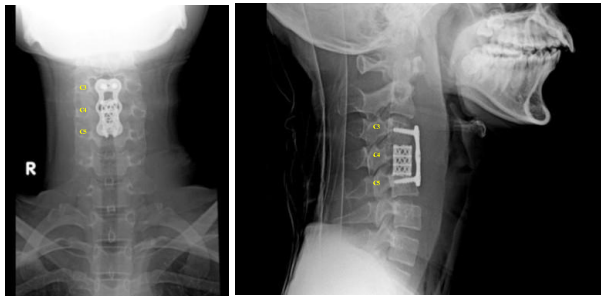


Figure 3: Post-operative cervical x-ray anteroposterior and lateral view. The C4 vertebral body defect is stabilized with anterior plate-and-screw fixation and a cervical mesh cage, with bilateral screws anchored in the C3 and C5 vertebral bodies (white arrows)

Postoperatively, the patient demonstrated significant neurological and clinical improvement. Upper extremity muscle strength improved from Medical Research Scale (MRS) grade 3/3 preoperatively to 4/4 bilaterally, while lower extremity strength remained normal at 5/5. The severe preoperative neck pain (NRS 9) completely resolved within one week after surgery (NRS 0). Sensory deficits below the C5 dermatome also resolved, and no bladder or bowel dysfunction was observed.

The patient was hospitalized for one week following surgery without postoperative complications. A comprehensive postoperative management program was initiated, including a 12-month anti-tuberculous drug regimen. This consisted of a four-drug induction phase for two months (isoniazid 300 mg, rifampicin 400 mg, pyrazinamide 1200 mg, and ethambutol 600 mg), followed by a continuation phase of isoniazid and rifampicin for ten months.

The patient also underwent a structured rehabilitation program focusing on neurological recovery and spinal stability. The program included trunk control

training, transfer exercises (supine to sitting and sitting to standing), diaphragmatic breathing and chest expansion exercises, active range-of-motion exercises for the upper and lower extremities, core strengthening with abdominal drawing-in maneuvers, standing balance training, and sensory re-sensitization. Cervical isometric strengthening exercises were performed two to three times per week (40–60% of one-repetition maximum, 10 repetitions, 2–3 sets, with one-minute rest intervals), with strict precautions to avoid cervical flexion, rotation, and autonomic dysreflexia.

At the six-month follow-up, the patient remained clinically stable with no signs of infection recurrence. Examination of the upper extremities showed normal muscle tone, no pain, swelling, or tenderness, preserved range of motion, and muscle strength of 4/5. Deep tendon reflexes were brisk (biceps and triceps +3/+3), with persistent Hoffmann and Tromner signs, but no functional impairment. Sensory and proprioceptive functions were normal.

Lower extremity examination was normal, full range of motion, muscle strength of 5/5, intact sensation, normal proprioception, and no pathological reflexes, clonus, or spasticity. The patient was able to ambulate independently and perform daily activities without assistance.

Table 1. Comparative Clinical, Radiological, and Surgical Characteristics of Two Adolescent Patients with Cervical Tuberculous Spondylitis

Parameter	Case 1 (Previously Reported) ⁷	Case 2 (Current)
Age / Sex	17-year-old male	18-year-old male
Duration of neck pain before diagnosed	6 months	3 months
Neurological progression	Tetraparesis over 2 weeks	Progressive upper limb weakness over 3 weeks
Autonomic dysfunction	Present (bowel & bladder)	Absent
Preoperative motor strength	UL 2/5, LL 3/5	UL 3/3, LL 5/5
Sensory deficit	Hypoesthesia below C2	Hypoesthesia below C5

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Vertebral involvement	C2–C4	C2–C5
Main collapsed level	C3	C4
Kyphotic deformity	Present	~36° kyphosis
Epidural compression	Severe anterior compression	Severe anterior compression
Intramedullary edema	Present	Present
Paravertebral abscess	~3.6 × 3.6 × 4.7 cm	~2.5 × 4.0 × 3.7 cm
Surgical procedure	C3 corpectomy + iliac crest graft + anterior plating	C4 corpectomy + mesh cage + anterior plating
Anti-TB regimen	12 months	12 months
Postoperative motor recovery	5/5 all extremities at 6 months	UL 4/5 at 6 months, LL 5/5
Residual signs	UMN None	Persistent Hoffman & Tromner sign
Functional outcome	Full recovery, no limitation	Independent ambulation, mild residual signs

DISCUSSION

Cervical tuberculous spondylitis represents a surgically challenging condition due to the risk of instability, deformity, and neurological compromise. Retrospective analyses of cervical spine tuberculosis have demonstrated that neurological deficit at presentation is a common indication for operative intervention, particularly in cases with vertebral body collapse and epidural compression.⁸ In the present comparative report, both patients exhibited multilevel involvement and radiological evidence of spinal cord compression; however, their neurological severity and recovery differed.

In both of our cases, anterior cervical corpectomy and fusion (ACCF) allowed direct removal of anterior compressive pathology and correction of kyphotic alignment. Large multicenter surgical series have shown that decompression combined with stabilization can achieve favorable outcomes in spinal

tuberculosis when adequate anti-tuberculous agents is administered. Surgical goals include radical debridement, neural decompression, correction of deformity, and restoration of spinal stability.⁹

Contemporary reviews emphasize that instrumentation in the setting of active infection is safe when combined with thorough debridement and appropriate anti-tuberculous therapy. The stability provided by anterior plating or cage reconstruction facilitates early mobilization and promotes neurological recovery. In both cases, anterior fixation resulted in restoration of cervical lordosis and stable alignment on follow-up imaging post operative, consistent with previously reported outcomes.¹⁰

The first case had been previously reported by our institution and presented with advanced tetraparesis and sphincter involvement, yet achieved complete neurological recovery following surgical decompression and structured rehabilitation.⁷ In contrast, the second case presented with upper limb predominant paresis without autonomic dysfunction and demonstrated substantial, incomplete motor recovery at six months. A recent case series examining upper cervical spinal tuberculosis during the pandemic similarly reported variability in neurological recovery despite comparable surgical strategies.¹¹

Interestingly, despite more severe neurological deficit in the first case, complete motor recovery was achieved. This finding suggests that neurological reversibility may depend not solely on deficit severity but also on factors such as the extent of reversible cord edema and adequacy of decompression. Recent prognostic studies have attempted to identify risk factors associated with postoperative neurological dysfunction in spinal tuberculosis. Factors such as severity of preoperative neurological deficit, degree of spinal cord compression, and duration of symptoms have been implicated in influencing recovery.¹²

Surgical approach selection remains individualized. In both patients presented, pathology was predominantly anterior. While anterior-only approaches are commonly used for subaxial cervical disease, combined anterior-posterior strategies may be indicated in cases with severe instability or extensive involvement.¹³

In our comparative cases, the first patient underwent autologous iliac crest graft reconstruction, whereas the second was reconstructed using a mesh cage and anterior plate. Both methods provided stable fixation

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and radiological evidence of alignment restoration. Reconstruction techniques in cervical tuberculosis vary, including autologous iliac crest grafts, structural bone grafts, and titanium mesh cages. Comparative studies have demonstrated satisfactory fusion and alignment restoration with both autologous grafts and structural substitutes when rigid fixation is achieved.¹⁴

The comparative analysis of our two cases highlights the heterogeneity of neurological presentation in cervical spinal tuberculosis and underscores that even severe neurological deficits may demonstrate substantial recovery when appropriately treated. Updated reviews on surgical management of spinal tuberculosis reinforce that the primary determinants of favorable outcome are early recognition of neurological deterioration, timely decompression, complete debridement, and adequate anti-tuberculous agents.¹⁵

Overall, these cases emphasize that multilevel cervical tuberculous spondylitis in adolescents may present with differing neurological patterns despite similar radiological severity. Individualized surgical planning and comprehensive postoperative management, including prolonged agents and structured rehabilitation, remain critical components in optimizing functional outcome.

CONCLUSION

Multilevel cervical tuberculous spondylitis in adolescents may present with variable neurological patterns and differing recovery trajectories despite comparable radiological severity. Surgical decompression combined with stabilization and appropriate anti-tuberculous agents can result in significant functional improvement, even in patients presenting with advanced neurological deficits. Comparative analysis of similar cases highlights the heterogeneity of cervical spinal tuberculosis and the importance of individualized surgical planning and comprehensive postoperative rehabilitation in optimizing neurological outcomes.

AUTHOR'S DISCLAIMER

The authors declared no conflicts of interest regarding the materials and methods used or the results presented in this paper.

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